Commonwealth of Kentucky
Department of Highways

A METHOD OF DEVELOPING ENGINEERING SOIL MAPS FOR KENTUCKY

A Pilot Survey of Fayette County

by

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August 28, 1957

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MEMO TO: D. V. Terrell
Director of Research

Soils maps and particularly engineering soils maps are proving to be most desirable in the planning and design stage of many types of structures and land developments. Problems associated with foundations, drainage, and soil behavior may be recognized at a very early stage during the preliminary location and site selection through the use of adequate soil maps.

The Department has been gathering engineering soils data for several years through routine design and soil profile type testing for construction projects. This information represents a rather widely scattered sampling of the entire state, depending, of course, upon the actual design needs for projects under consideration for new grade type construction. This information has usually been specified for roads on the primary Federal Aid System of highways.

About two years ago the Research Division began a mapping program designed to adapt existing U.S. Department of Agriculture soils maps for engineering purposes. These pedological maps contain an excellent delineation of soil series, have been prepared in considerable detail, and have required, of course, quite an expenditure in the preparation. Their adaptation involves primarily the determination and assignment of engineering properties to the soil areas already mapped pedologically. Soil classification and bearing values along with desirable engineering properties have to be determined for the areas.

The report by R.C. Deen is in two parts. The first section, "A Method of Developing Engineering Soils Maps for Kentucky", outlines the background for an engineering soil survey of the entire state. The second section is a pilot survey and presents data for Fayette County.

The type of information presented should prove extremely valuable in the location and design of engineering structures. These data can be expanded to cover several counties that presently are mapped pedologically, and eventually this information could include all 120 counties. It would not be necessary to re-sample and test a soil series each time it appeared, except to check continuity and conformity. Mercer County is the next in the sequence planned for study. Because of the existence of similar soils series it will be necessary to sample only 7 of the 14 series in Mercer County.

Respectfully submitted,

W. B. Drake

W. B. Drake, Acting
Assistant Director of Research

WBD:dl
Enc.
cc: Research Committee members
Bureau of Public Roads (3)

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BACKGROUND FOR AN ENGINEERING SOIL SURVEY OF KENTUCKY

Chapter I*

INTRODUCTION

The information available from an engineering soil survey and map of the State of Kentucky would have practical application for several fields of engineering; the data would be by no means restricted to the design and construction phases of the development of engineering structures. Great economies might be accomplished if such data on soils were made available and utilized during the very earliest stages of planning and site selection; yet in the past the character of the soil has been only a minor consideration in the selection of a site. Often soil conditions have not been considered at all, since the practice commonly is to take soil borings only after a site has been selected.

The problems encountered in the use of the many soils of the state are numerous. Probably the most important, particularly in terms of pavement construction, is that of supporting power. When it is realized the soil supports, ultimately, virtually all engineering structures, its importance is forcibly brought to the front.

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* Some of the material in Chapters I and II has been taken, directly or indirectly, from a previously published report, written by the author: Deen, R. C.; "Kentucky Soils: Their Origin, Distribution and Engineering Properties". This was originally presented at the Kentucky Highway Conference, University of Kentucky, Lexington, March 29, 1956. It was later published, first in a combined report of the Highway Materials Research Laboratory, Kentucky Department of Highways, Lexington, June 1956. This was then reprinted in "Some Technical Papers: Kentucky Highway Conference"; Engineering Experiment Station Bulletin No. 40; University of Kentucky, Lexington, June, 1956; pp. 47-54.

Numerous other soil problems result in connection with the relationship between the subgrade and the pavement performance. Frost heave, which has received special attention in recent years, is now known to vary with the type of soil. Pumping of joints and cracks in concrete pavements is also associated with soil type. If a soil is known to be subject to frost heave or pumping, corrective measures should be taken during construction to reduce the probability of their occurrence.

With a knowledge of the engineering characteristics of soils, and the occurrence and distribution of these soils, estimates of excavation quantities and conditions can often be made with accuracy. The properties of foundation materials, including those at dam sites, can be determined with reliability.

With the increase in earthwork required by the construction of highways with modern grades and sight distances, embankment problems have increased also. The possible locations of suitable construction materials can be made from information presented in an engineering soil survey and map.

Drainage is an important problem encountered in highway and airfield engineering. With a knowledge of the drainage characteristics of a soil, the water supply, both surface and ground, and drainage conditions likely to occur in the field can be better estimated.

At present there is no single source of information which presents the engineering characteristics of the soils of Kentucky. When such information is desired, detailed investigations of individual projects are made. These studies are often conducted after the site has been selected and thus the data are not available for preliminary reconnaissance.

Engineering soil surveys and maps can be used in four major ways by engineers: 1) to make soil-reconnaissance surveys, 2) to locate sand and gravel deposits, 3) to organize and check field surveys, and 4) to correlate pavement and structural performances with soil type. In soil-reconnaissance surveys, the maps may be used for preliminary site selection by taking advantage of favorable soil and drainage conditions and avoiding the undesirable situations -- the soils maps making it possible to note the areas where these conditions prevail before ever going into the field. Sand and gravel deposits can be located readily if it is known what soil types are associated with or developed from them.

Soil maps can be used to a great advantage in organizing and checking field sampling. Since a soil type will have the same engineering properties wherever it is mapped (see Chapter II, Pedology Section), it is unnecessary to sample at regularly spaced intervals. One or two check samples could be obtained from each soil type area, allowing more time and effort to be spent in problem areas.

The intelligent use of engineering soil surveys and maps can reduce the time required in making surveys for engineering locations, and the association of engineering performance with the soil type name provides a convenient means of cataloging and filing of soils information.

Chapter II

SCIENCES OF SOIL INTERPRETATION

To a pedologist soil is a natural body of minerals and organic constituents, differentiated into natural horizons -- usually unconsolidated -- ranging in thickness from a mere film to a maximum of somewhat less than ten feet, which differs from the material beneath it -- also usually unconsolidated -- in morphology, physical properties and constitution, chemical properties and composition, and biological characteristics. This definition follows that of pedologists Curtis F. Marbut and Jacob S. Joffe (32), and limits the soil to the surface or near-surface materials which are natural media for the growth of plants.

From the geologic viewpoint soil is the relatively thin layer of disintegrated rock lying on or near the surface of the earth, mixed with the organic matter which is the product of decaying vegetation. Thus, soil is the result of the residual concentration of the alteration products of rock, which in turn have been changed by the influences of chemical and physical processes and living and dead organisms. It is underlaid by the subsoil, which is made up of rock fragments and contains little organic matter.

From the engineering standpoint soil includes everything -- gravel, sand, silt, clay, badly shattered and soft rock -- from the earth's surface to solid rock. Thus the engineer engaged in the design and construction of structures encounters problems which lie within the realms of each of these sciences. The engineer must understand and be familiar with the entire soil profile down to and, in some cases, even into the bedrock.

The need for information on these materials for use in the location, construction and maintenance of engineering structures is generally accepted. Field and laboratory methods used to gather such information are many and varied -- and often too expensive for use in preliminary reconnaissance surveys. There is, therefore, a need for the development and use of short-cut methods.

When information on soil conditions is desired for large areas where detailed studies are not available or would be uneconomical to conduct, it can be inferred from aerial photographs and pedologic and geologic maps and surveys. Much work has been done, particularly with aerial photographs and pedologic surveys, to develop correlations and methods of interpretation of the information in these sources in terms of engineering characteristics of the soils.

PEDOLOGY

The agricultural soil scientists have developed a classification and mapping system which they can use to predict soil properties that concern agricultural productivity. Many areas have been mapped by such methods, and many more are in the process of being mapped (see Fig. 1). These soil maps and surveys contain a wealth of information that would be highly useful to the soils engineer. They are not, however, reported in terms familiar to him; and this source of invaluable soils information remains largely unused by engineers.

Pedology has been briefly defined as "... a branch of the science of soils, ... an independent science dealing with the soil as a natural body" (32). Pedology deals with the origin, formation, and

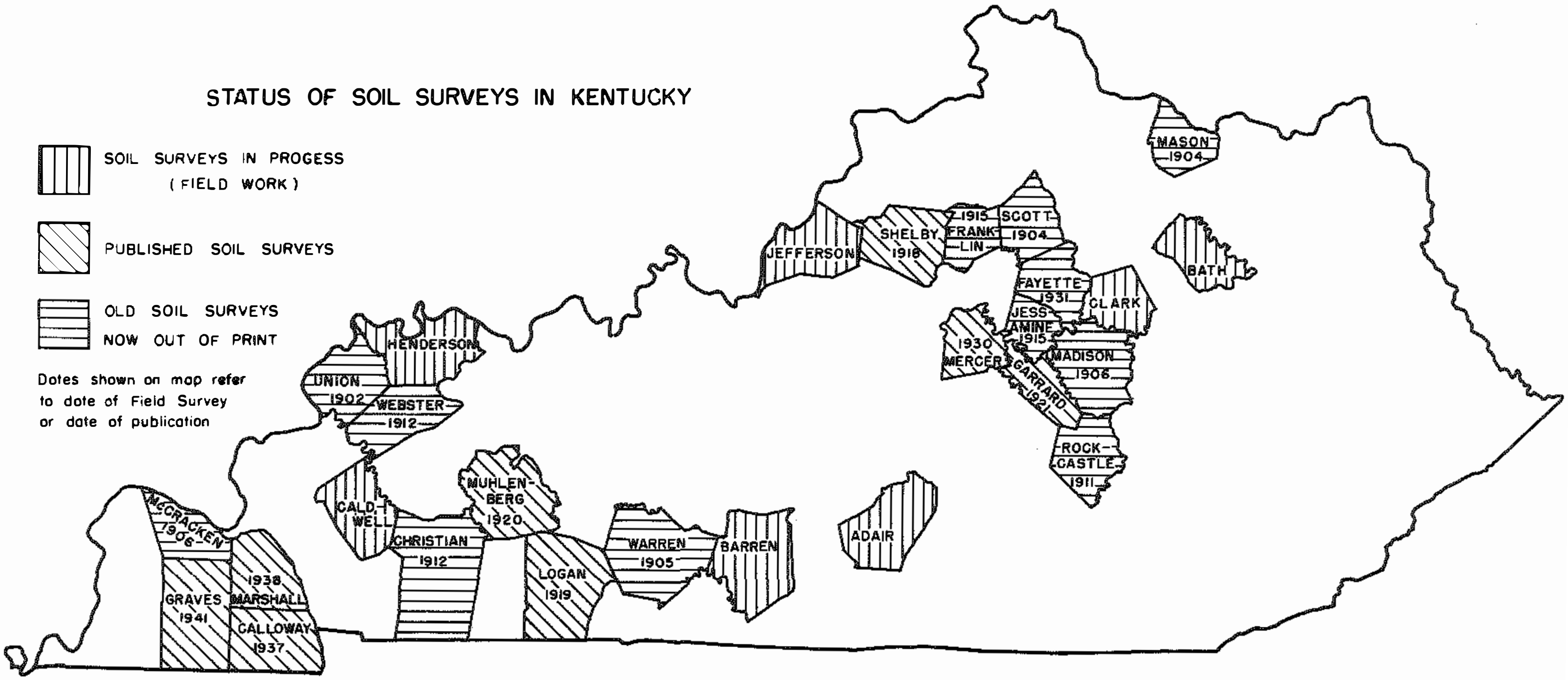


Fig. 1 - Status of Soil Surveys in Kentucky.

distribution of individual soil profiles, presenting each as a natural unit. This presentation is made through a study of each profile's constitution, its life, and its dynamics.

Classification and Identification

Soils are classified by pedologists after very detailed investigations. The basis for this classification is implied in the definition of pedology, and includes consideration of the morphology and chemical composition of the soil itself, and the geology and nature of the parent materials.

The primary objective of morphology is description; thus soil morphology is nothing more than a description of the soil body, its appearance, features, and characteristics. Normally, the properties described are these: 1) color, 2) constitution, 3) number and relative arrangement of the horizons, 4) depth of profile and thickness of horizons, 5) texture, 6) structure, 7) concretions and foreign intrusions, and 8) miscellaneous observations.

Color is the most obvious and easily determined of soil characteristics, and much may be inferred from it concerning the composition and factors affecting the soil. The variations of color are due primarily to organic matter, iron compounds, silica, and lime. The organic matter imparts the black-to-gray tinges, the iron the red, brown, and yellow tinges, and the silica and lime are responsible for the light tinges. A single horizon may be uniform in color or it may be streaked, spotted, or mottled in many ways. Local accumulations of lime or organic matter may cause mottling. Streaking may be caused by constituents from overlying materials seeping down into a horizon. Certain mottled color combinations -- grays and browns with a bluish or greenish tinge -- indicate impeded drainage.

As the soil material is acted upon by soil-forming processes, the profile gradually takes on a definite build known as profile constitution. The chief attributes of the soil profile constitution are compactness, cementation, porosity, consistency, plasticity, and stickiness. These attributes deal with the resistance to deformation; that is, with the degree and kind of cohesive and adhesive strength.

The soil texture is determined by the proportions of the various size groups of individual soil particles in the soil mass, specifically of clay, silt, and sand.

The aggregation of the primary soil particles into variously shaped and sized compound particles is referred to as the soil structure. Natural soil aggregates are called peds, in contrast to clods -- which are masses formed by a disturbance and which slake with wetting -- and to fragments caused by rupture of the soil mass across natural planes of weakness, or to concretions caused by local concentrations of compounds that irreversibly cement the soil particles together.

The consideration of these many factors in identifying soils results in a large number of soil classification groups.

A <u>soil series</u> is a group of soils having horizons similar in differentiating characteristics and arrangement, developing from the same kind of parent material, and differing only in the texture of the top horizon. There are 208 soil series presently recognized and used in Kentucky. The Appendix to this report gives a list of these approved soil series used in Kentucky. The principal soil unit used by pedologists in mapping is an even more refined one, the soil type. This unit is similar to the soil series, except that within a soil type the texture of the top horizon does not vary significantly.

An engineering appraisal of the same profiles would, however, minimize such factors as color and chemical composition, thus allowing a regrouping into less refined classes for engineering purposes. In addition, the refinement into soil types for engineering purposes is not necessary, since good construction practice includes the removal of the "topsoil". Investigations in Indiana (8) indicate the advisability of combining as many as 15 or 20 soils into one group. From the highway and airfield engineering viewpoint these soils are practically identical.

Origins of Soil

The first step in the development of soil is the formation of the parent material through the weathering of solid masses of rock. This material may remain in place or be transported to another area by wind, water or ice. The parent material, either residual or transported, is primarily a storehouse of future soils and plays a relatively passive part in soil formation. The distinguishing characteristics of the great soil groups are primarily the results of climatic and biologic action upon the parent material. However, many soil subdivisions owe their distinctive characteristics to the parent material.

Rocks include both consolidated (hard) and unconsolidated (soft) mineral and organic material. The rocks of the earth are of three kinds: igneous (or primary), sedimentary, and metamorphic.

Igneous rocks, formed by the hardening of molten lavas, are composed of different minerals in various proportions. Coarsely crystalline textures develop when the lavas cool very slowly, and textures are finely crystalline or glassy when the cooling has been very rapid. Another important class of igneous rocks includes those formed from fragments and ash blown from volcanoes. Many of these rocks are porous masses of finely divided glassy or crystalline particles.

Sedimentary rocks include materials that have been deposited by wind, water, or ice. The rocks formed from materials laid down by water vary in texture from coarse gravels to the finest clays. Aeolian (wind) deposits consist almost entirely of loessial silts and sands and are usually unconsolidated. Many glacial deposits consist of unconsolidated and unstratified gravels, boulders, sands, and clays; while others have been reworked and stratified by water or wind.

When igneous or sedimentary rocks are subjected to intense heat or very high pressures or both, their structures and mineralogical compositions are changed. This process is called metamorphism and the products that result are called metamorphic rocks.

The geologic weathering agents which result in the formation of the parent material include physical disintegration or reduction, essentially a separation from the mass and a decrease in particle size, and chemical decomposition, involving complex alteration of the chemical constituents.

Primary physical weathering includes the loosening and breaking up of rocks. Joints and bedding planes are the first lines of attack. The daily and seasonal variations in temperature cause differential expansion and contraction within the rock, setting up stresses which gradually cause it to crumble. Rapid temperature variations -- especially those which cross the freezing point of water -- are very active in this process. Plant roots are potent agents of physical weathering, penetrating into cracks and crevices and exerting tremendous pressures, which cause the rock to split.

The products of the primary methods of physical weathering are further acted upon by secondary processes. Rock fragments are collected by rivers and streams, rolled along their beds and reduced to finer particles. Waves of lakes and seas produce a grinding action which reduces the size of fragments along the shores. Glaciers collect loose fragments and not only grind them into smaller sized particles but also use these same fragments as tools for gouging out more material from the rock beneath. Much physical weathering in arid and semiarid regions, where vegetation is sparse, is done by the scouring action of sand carried by the wind.

Physical weathering merely changes the form, while chemical weathering can alter the composition of the rock while it is still in the massive form. Only few minerals are not subject to the action of oxygen and even in arid regions sufficient moisture is present to promote this reaction. The products of oxidation are split off and some are washed out leaving the remaining materials subjected to weathering by other processes.

In hydration, water combines with other constituents resulting in tremendous volume increases, ranging from very slight to as high as 160 percent. These volume changes produce stresses which are often sufficient to break up the rock.

Hydrolysis is considered by some to be predominant in the chemical weathering of rock. Essentially an exchange of component parts between the minerals and water ($CaSiO_3 + 2H_2O \leftrightharpoons Ca(OH)_2 + H_2SiO_3$), it results in the formation of two substances having properties different from those of the original mineral-water mixture. In this reaction, although the calcium hydroxide may be washed away, it may react with the carbon dioxide of the air or of the soil water to form calcium carbonate. In this process of carbonation the carbonates may accumulate in the soil or be washed away, depending on the supply of circulating water.

Closely associated with the other processes of chemical weathering is water, the universal solvent. The solvent action of water alone is very slow, but with certain salts or acids in solution it increases tremendously. The chemical effects of the biosphere are great. The roots of all plants secrete carbonic and other acids which act upon rocks and minerals.

The processes of weathering are not at work independently. Several or all of them usually complement one another, inter-reacting in a variable combination (see Fig. 2).

Soil Profile Development

Soil differences depend not only upon the nature of the rock from which the parent materials were weathered but also upon whether these materials have remained in their original positions or have been moved and redeposited, and if the latter, by what agency. Where the parent material has not been moved, the soils are known as residual. These soils consist primarily of the insoluble residue of the rock material after the soluble material has been removed by leaching and erosion. Residual soils are widely distributed throughout Kentucky

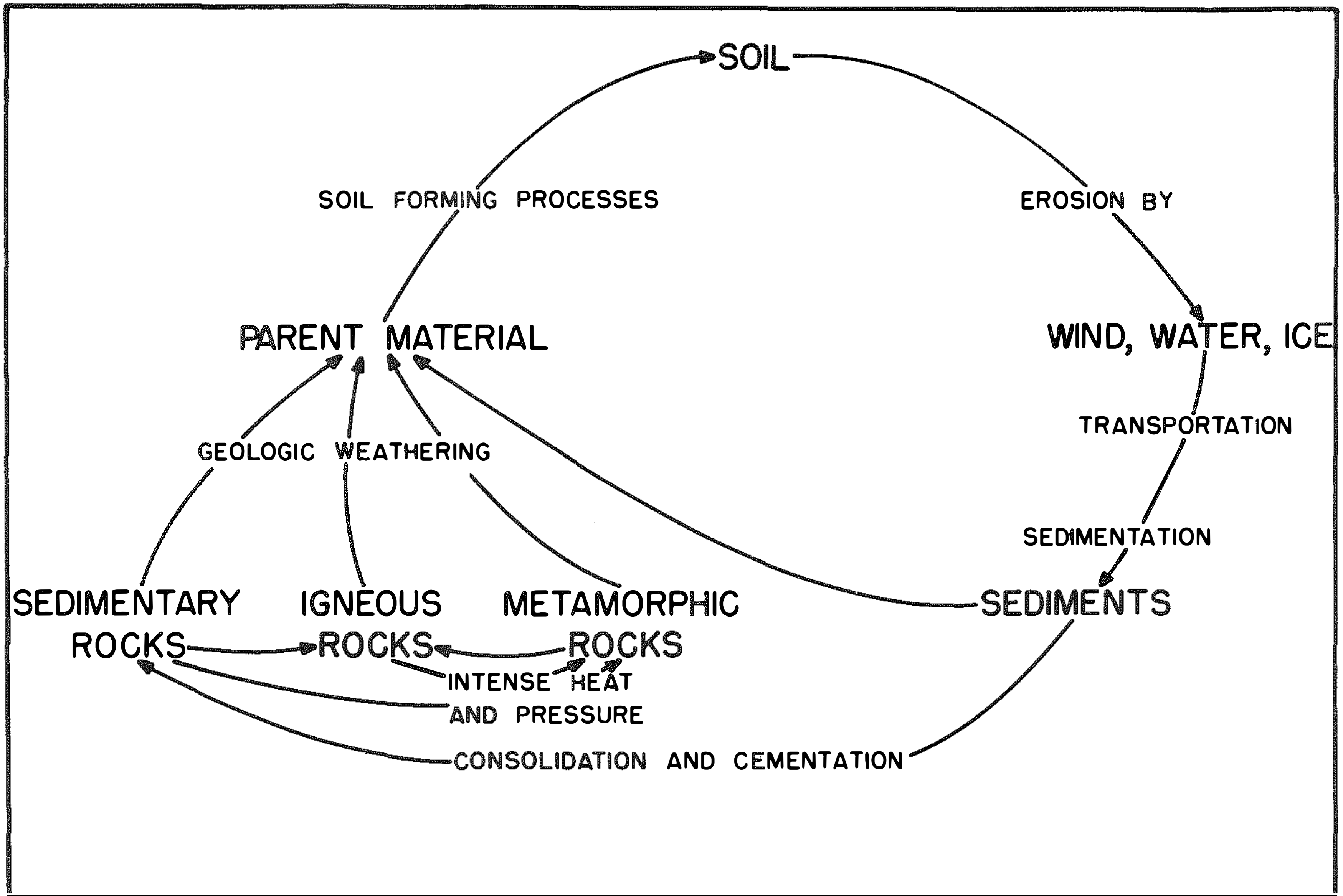


Fig. 2 - The Soil Material Cycle.

and were derived from sandstone, shale, and limestone rocks, either singly or in various combinations. Where the parent material has been moved and redeposited by water, the soils are known as alluvial; where the moving and deposition has been by wind, as aeolian; and by moving ice sheets, glacial.

Most of the upland soils of Kentucky have been formed from residual materials. Bottomland soils, which are extensive in many parts of the state, were derived from alluvial materials. A fine wind-blown material known as loess covers a considerable portion of the Jackson Purchase area as well as other parts of the state, principally along the Ohio River. A small area along the Ohio River from Oldham County to Bracken County has been affected by glaciation.

The material, whether residual or transported, that results from the weathering of massive rock is further modified in the surface or near-surface layers. Under the influence of climate and living organisms, soil material develops into more or less distinct layers or horizons.

This series of layers that can be observed in any given soil is known as its profile, the characteristics of which are the product of the characteristics of each layer. The profile is considered as a natural body and not as a series of unrelated layers; the effects of the soil are the result of the combined properties of all layers.

The degree of profile development is dependent upon the intensity of activity of the different soil-forming factors, on the length of time over which they have been active, and on the resistance of the parent material to change. Soils are dynamic, normally reaching a state of near equilibrium with their environment after long exposure to a given set of conditions. At any stage of development, the soil may be affected by mechanical agencies. Balanced with the material lost from the surface by erosion is the parent material that is gradually acted upon by the soil-forming processes at the lower levels. Normal erosion is the removal of surface soil at the same rate that the soil-forming processes penetrate to greater depths, thus maintaining a constant depth of soil.

Classically, the soil profile is divided into four principal zones. The uppermost is the organic or humus layer, primarily an accumulation of decayed organic matter. The eluvial layer is the zone from which constituents have been removed by percolating water, and the illuvial layer is the zone of accumulation of the material removed from the eluvial zone. The lower zone consists of the unaltered parent material.

The processes of eluviation and illuviation do not fully explain the development of many soil profiles. In the case of residual soils, the profile develops through the weathering of the rock, and therefore a ready mixed material with all fractions represented throughout is not available, as is the case in glacial materials. Eluviation and illuviation require the development of a clay pan, which is not generally found in residual soils.

The horizontal layers of the profile are called horizons, differing from one another in such properties as thickness, color, structure, and texture. The separate horizons are referred to by the letters, A, B, C, and D. The A horizon is the upper part of the profile, in which life is most active and abundant. It includes the humus zone and the zone of eluviation. The zone of illuviation, the B horizon, is usually marked by deeper colors and finer texture. The unaltered parent material is designated the C horizon, while any underlying strata not generically related to the parent material are called the D horizon (see Fig. 3).

Soil is the product of the action, conditioned by topography, of climate and living organisms upon the parent material. The degree to which these agents affect the material is controlled by the length of time over which they act. Altogether there are five major interdependent factors of soil formation: 1) climate, 2) biological activity, 3) parent material, 4) topography, and 5) time.

Local climate, primarily a combination of precipitation and temperature, affects the development of soils by the moisture and energy it contributes to the environment. It is directly or indirectly responsible for the variations in plant and animal life, for major soil differences, for the shaping of the land masses, and for the character of many rock formations. Affecting the weathering of both the massive rock and of the soil materials, it is responsible for the removal and redeposition of materials by wind, water, and glaciation. Percolation is also established and maintained by the effects of climate.

Pedologists have found that over extensive areas of the world with similar climates soil profiles tend to show certain similarities, apparently reflecting the influence of the climate. By a broad generalization, the soils of the world have been arranged into five groups, corresponding to the five major climatic zones of the world (see Fig. 4).

Tundra soils have developed under frigid climates with low precipitation. The development of the profiles has largely been the

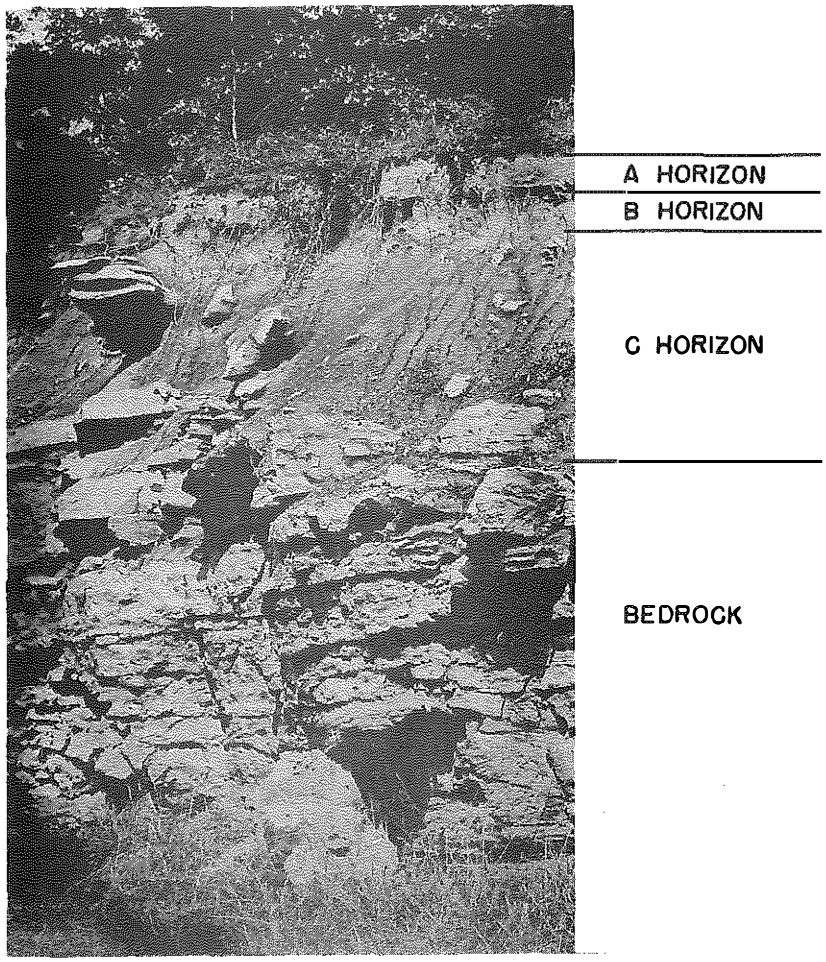


Fig. 3 - The Soil Profile.

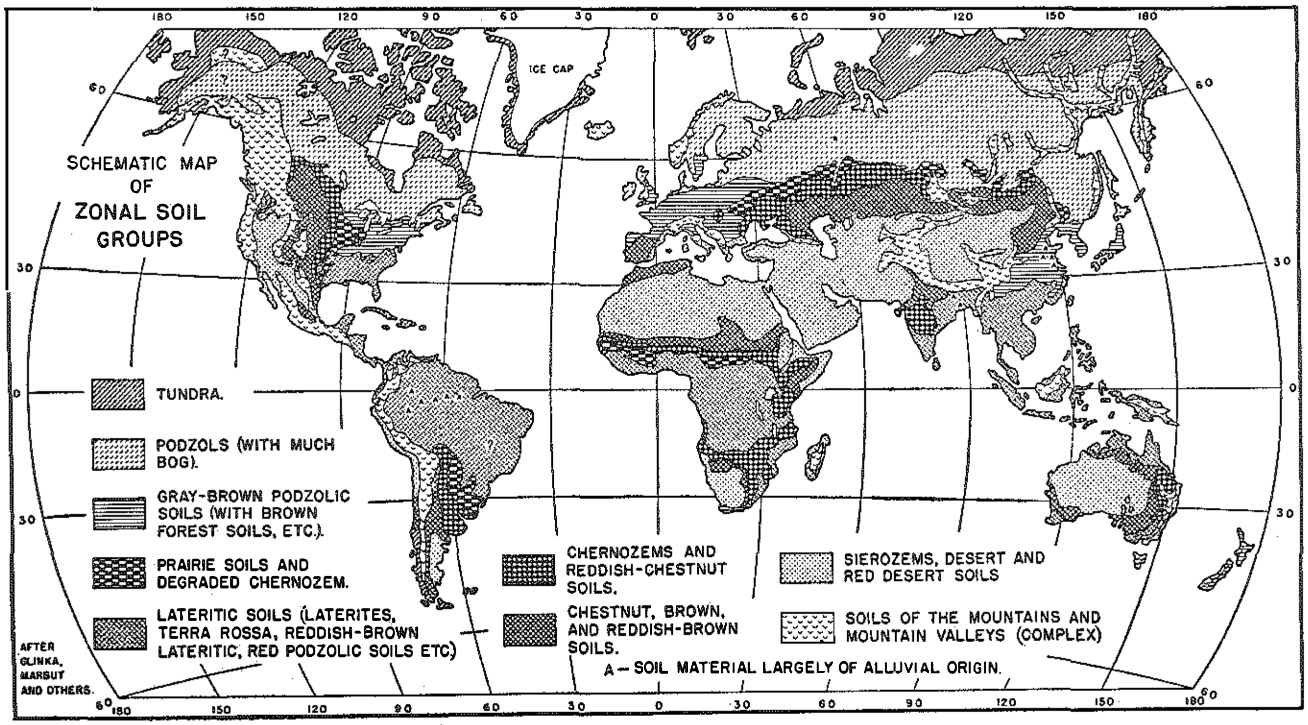


Fig. 4 - Generalized Soil Map of the World.

result of physical weathering associated with the mechanical action of frost heave. As a result, the soils are relatively shallow and tend to be high in silt and low in clay content, with a uniform texture throughout the profile.

The Podzolic soils have developed in the humid temperate climates, where chemical as well as physical effects are important. The soils are leached and the subsoil is generally heavier than the surface layer above and the parent material below.

In the subhumid and semiarid temperate climates, the Chernozemic soils have developed, showing both physical and chemical effects of climate. These soils are only slightly leached and thus show less textural variation with depth than the soils of the Podzolic group. Organic material is well mixed with the soil throughout the upper foot or two, whereas an organic mat develops on the surface of the Podzolic soils.

Desertic soils develop under arid climatic conditions and are largely the result of the physical breakdown of the parent material. The soils are unleached and show only slight textural variations within the profile.

The Latosols have developed in humid and wet-dry tropical climates. The chemical effects of such climates greatly overshadow the physical effects. The soils are deep, highly leached, and predominately red in color. High in clay and low in silt content, they are, however, friable and permeable. Unlike the Podzolic soils, the Latosols show a gradual increase in clay content from the surface downward.

Under this broad classification, Koppen (22) places the entire state of Kentucky in the regional climatic zone of the warm, temperate, rainy type. This climate is without a dry season; that is, the wettest month of the winter has less than three times the precipitation that falls during the driest month of the summer. Koppen also speaks of this regional climate type in terms of hot summers with the mean temperature of the warmest month being greater than 72°F. The soils of Kentucky would then be predominately of the Podzolic group.

In many locations, however, the local or spot climate may be sufficiently different from the regional climatic conditions to cause variations in soil development and properties. Lake influences, forest influences, variations in mountain crest, slope and valley climates, and the influences of human settlements and activities may be of importance in Kentucky in affecting local climates. Nevertheless, from an engineering point of view, the soil forming factor of climate may be considered uniform in a relatively limited area such as a state and very definitely in a county.

Biological activity is the other active soil-forming factor. Plant and animal life supply the organic matter for the soil. Percolation is modified by the paths made by plant roots and burrows of small animals. Microorganisms break down organic debris and this decay results in the formation of various organic acids which, in solution, hasten the leaching of the soil material. These biological influences may also be, like climate, considered uniform over the state of Kentucky.

Certain passive factors of soil formation account for the rate and degree of horizon development. The rate is particularly affected by the texture of the parent material and its resistance to change. In "young" soils the profile is shallow and weakly developed, with the parent material lying near the surface and strongly influencing the profile. In older soils weathering has reached to greater depths, thus decreasing the effect of the parent material upon the profile. In areas where chemical weathering is important the tendency is for the soil to lose the characteristics of the parent material.

Topography, particularly the ground slope, materially influences the soil formation processes because of its controlling effect upon drainage, runoff, percolation, and erosion. Soil profiles on steep slopes are generally weakly developed. This retarded development is due to rapid runoff, erosion and decreased percolation. In low areas and depressions where the ground-water level is near the surface, the profile development is distorted.

Time of weathering affects the degree of soil formation directly. The time required for the development of a "normal" soil is probably greater in dry regions than in humid ones. Soils on steep mountains are generally young in years but even younger in stage of development. The ages of soils on flood plains are also slight. It seems reasonable to consider the "age" of soils to be their state of maturity rather than their chronological age. No useful general statement can be made to define the rate of formation of soils, since some form very rapidly, others extremely slowly.

PHYSIOGRAPHY AND GEOLOGY

Since climate and biological activity may be considered uniform over the state, the parent material, topography, and age thus become the important factors in determining the distinguishing characteristics of a Kentucky soil. A knowledge of the physiography and geology is therefore an important part of the background necessary to make an intelligent classification and interpretation of soils.

Physiography is the study of the shapes, sizes, and relationships of the earth's surface features. Physiography differs from topography in that it attempts to explain the origin and present condition of the surface relief whereas topography deals only with the configuration of the surface. Since physiography does attempt to explain the history of the surface of the earth, it is closely related to, and inseparable from, geology.

Kentucky Geology

The geology of Central Kentucky is largely controlled by the Cincinnati Anticline, a broad arch that stretches north and south through the central portion of the state, reaching a peak in Jessamine County. To the west the strata dip into the broad syncline of the Western Coal Field. The dips of the strata on the flanks of the Cincinnati Arch are quite gentle and can not be detected by the eye. This arching, however, has been sufficient to allow erosion to be active, exposing on the surface of the dome the oldest formations in the state. Proceeding outward from the Jessamine Dome, the younger formations are exposed in a concentric arrangement.

An examination of the physiographic and geologic maps (see Fig. 5 and 6) shows the concentric arrangement of the oldest formations, Ordovician, at the center, with the successively younger formations appearing as retreating circles of plateaus. The outer circle of Pennsylvanian age has been broken into two separate areas, the Eastern and Western Coal Fields, by the erosional action along the axis of the Cincinnati Arch.

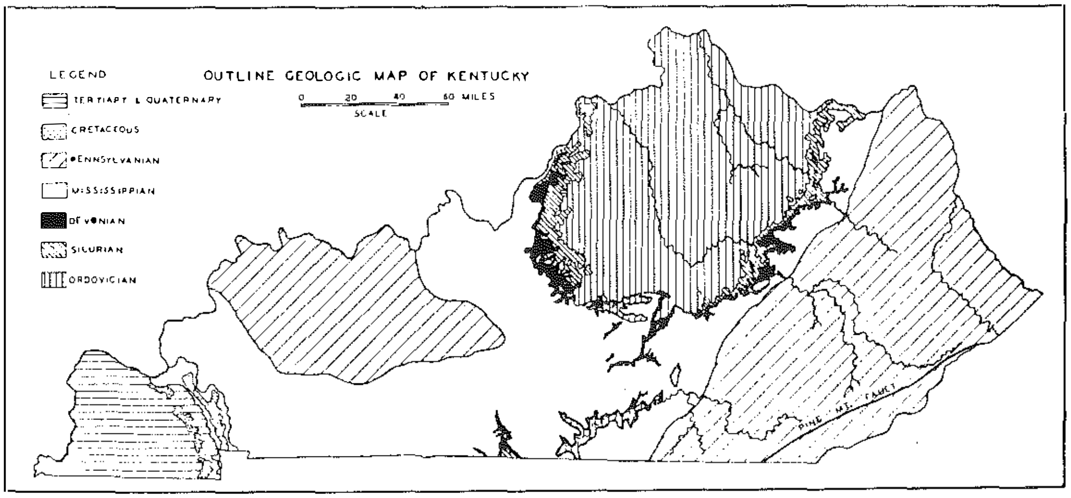


Fig. 5 - Geologic Map of Kentucky.

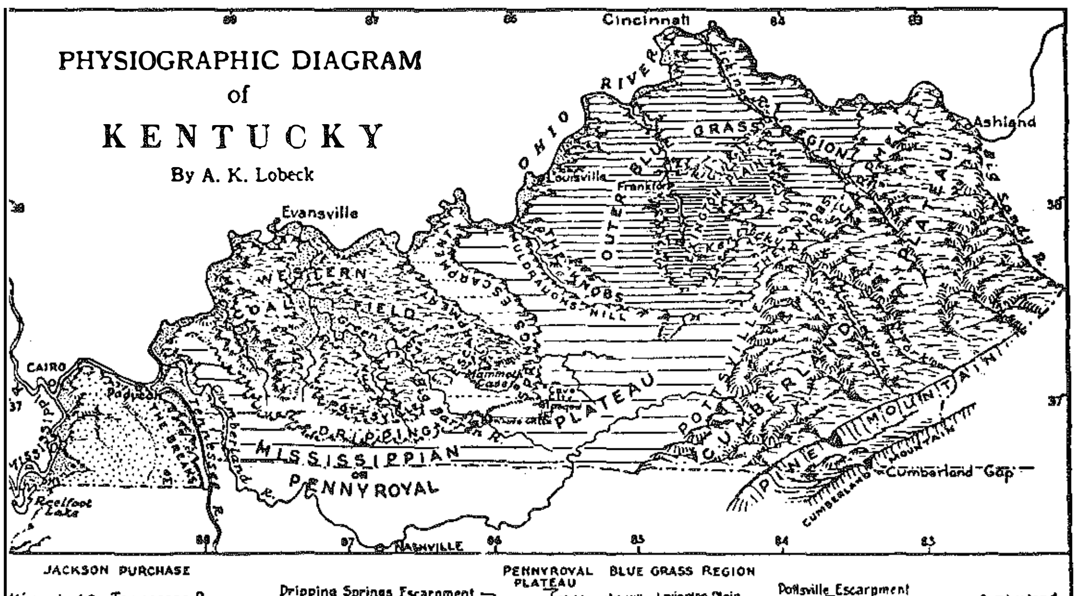


Fig. 6 - Physiographic Diagram of Kentucky.

To the west of the Tennessee River lies an area that was not raised above sea level until late geologic time. This area, the Jackson Purchase, was at the head of an embayment of the Gulf of Mexico during the Late Cretaceous and Tertiary Periods, and received deposits of sand, gravel and clay.

Very little of the state has felt the effects of glaciation. A small area along the Ohio River from Oldham County to Bracken County has deposits that can be ascribed to glacial activity. The deposits are imperfectly consolidated loess with pebbles and occasional boulders of Northern origin. Glacial outwash deposits are also recognizable from Trimble to Jefferson Counties.

Physiography of Kentucky

The topography of Kentucky has been divided into six definite regions, each reflecting the character of the underlying geologic formations. The six physiographical regions of Kentucky are: 1) the Blue Grass, 2) the Knobs, 3) the Eastern Kentucky Mountains, 4) the Mississippian Plateaus, 5) the Western Coal Fields, and 6) the Jackson Purchase.

The Inner Blue Grass region, or Lexington Plain, includes most of Fayette, Scott, Woodford, Jessamine, and Mercer Counties. This is a lowland with a gently rolling terrain. Rivers in the area have entrenched themselves to depths of 400 and 500 feet. Since many of the constituents of limestones are soluble, solution channels, as well as caves and sinkholes, are not uncommon, and much of the drainage is through these.

The level uplands have developed deep residual soils derived from limestone. Physical tests show that such soils are relatively plastic; yet these are well drained internally because the bedrock allows the water to escape through cracks, joints and solution channels and because the soils develop a fragmentary structure. However, when the natural soil structure is destroyed in earthwork operations for engineering purposes, the soils become plastic and react in much the same way as other clay-like materials.

The area encircling the Lexington Plain is known as the Outer Blue Grass, including the Eden Hill Country. The comparatively impervious and easily eroded shale has produced a rough, hilly country (see Fig. 7). The soils of the Eden Hills have been formed by the decomposition of limestones and shales. The valleys are narrow and winding, entered by numerous streams which require many culverts and bridges. The soil is highly plastic and provides poor pavement support at normal moisture contents, while cut slopes frequently produce landslides and are a major engineering problem.

Proceeding outward from the Jessamine Dome, the soils of the Outer Blue Grass become more similar to those of the Inner Blue Grass. The upper horizons are more suited as subgrade material than the Eden Shales, although the parent material is very similar to that of the Eden. It is fortunate that the gently rolling nature of the terrain (see Fig. 8) requires lighter cuts, so that little of the undesirable clay finds its way into the subgrade.

Surrounding the Blue Grass limestone country is a narrow belt of land known as the Knobs area, characterized by the conical knobs (see Fig. 8) that are the erosional remnants of former uplands to the south and west. This is a narrow shale area with the Mississippian Plateaus to its west and south, and the Cumberland Plateau of the

Fig. 7 - Topography of the Eden Hill Country.

Fig. 8 - The Gently Rolling Terrain of the Outer Blue Grass. In the background are the conical knobs that encircle the Blue Grass Region.

Eastern Mountain area to the east. It is a region of rough topography but with the major stream beds flat and wide.

The Mississippian Plateaus form a broad belt to the west and south of the Blue Grass, encircling the Western Coal Field. This belt is a rolling upland plain formed from limestone, with small local relief (see Fig. 9). Except for the larger rivers, the drainage is underground. The gently rolling topography and lack of surface drainage favor the development of thick, residual soils, similar to those of the Blue Grass area. These soils are usually good in highway construction. In deep cuts, however, a great deal of plastic, unstable clay is frequently encountered.

The region centered around Madisonville is the Western Coal Field, a topographic as well as a structural basin. The country is a dissected plateau with rolling hills and moderately wide valleys. An outstanding feature of this region, as well as of the Jackson Purchase, is the broad alluvial bottoms of the larger rivers. The soils of this area, formed by the weathering of sandstones and shales, are similar to those of the Eastern Coal Field.

The Eastern Coal Field, a region characterized by a rough topography with narrow ridges and deep, narrow valleys, includes all of the state east of the Pottsville Escarpment. Flat lands are at a minimum; but locally, in areas of shale outcrop, numerous bottomlands have developed. Massive sandstones have given rise to local upland flats.

The soils derived from these sandstones and shales are usually quite good subgrade material. Because of the rugged terrain, the deep cuts and high fills required in highway construction consist predominantly

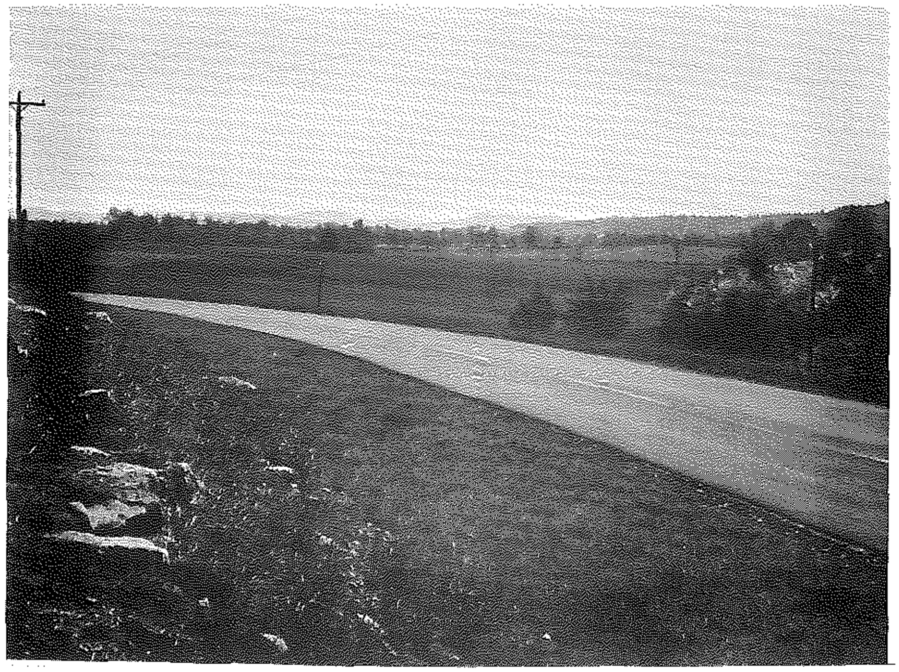


Fig. 9 - The Gently Rolling Terrain of the Mississippian Plateaus. The Pottsville Escarpment rises in the background to the Cumberland Plateau of Eastern Kentucky.

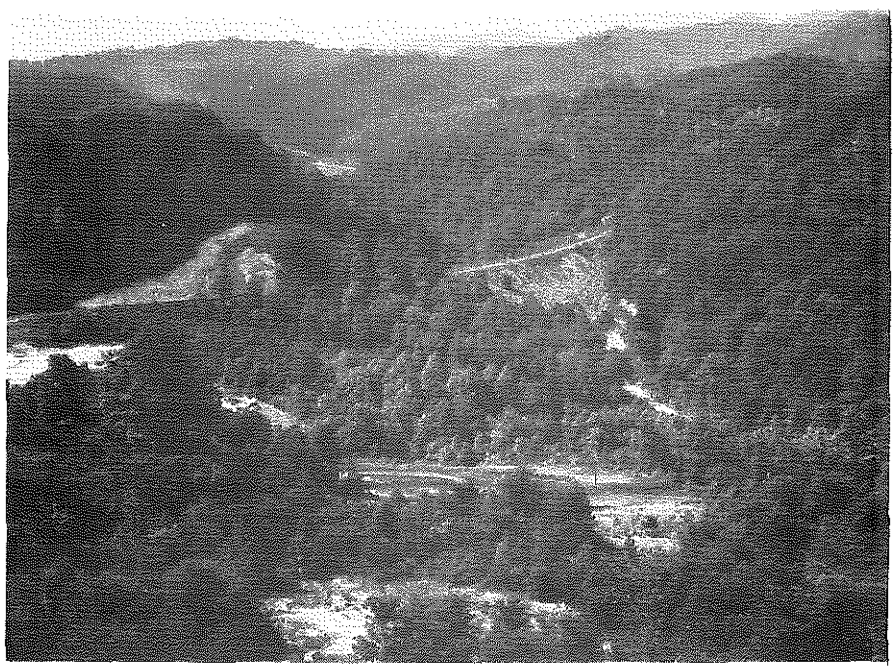


Fig. 10 - The Rugged Terrain of the Eastern Coal Field. The photograph shows the deep cuts and high fills required in highway construction.

of sandstones and shales (see Fig. 10). The bedrock in this area thus becomes of great engineering significance.

The Jackson Purchase, an undulating plain with very little local relief, lies in the Gulf Embayment, a coastal plain region. The area has been covered and the soils are greatly influenced by the wind-blown loess, which overlays all older materials. Floodplains of large extent have formed along the Mississippi, Ohio and Tennessee Rivers.

AIR PHOTO INTERPRETATION

The use of air photos to obtain information of interest to the soils engineer is of inestimable value. Pedologists are presently using aerial photographs in pedological mapping; geologic surveyors rely upon the interpretation of air photos in preparing geologic maps and surveys; and aerial photography played a very important role in the recently completed topographical mapping program of Kentucky.

Even though an engineer does not use aerial photographs directly when he investigates the soil conditions of an area, he unknowingly places great confidence in the use of air photos when he uses up-to-date pedologic, geologic, and topographic maps and surveys. When he uses such maps and survey reports, he is not, normally, doing any actual mapping himself. His task is merely to extract engineering significance from the features that have already been mapped. This may be done by inference or by field sampling and testing and laboratory testing.

The soils engineer would find it very convenient if the areas in which he were interested had already been mapped by the pedologists. Unfortunately this is seldom the case. There have been only twenty

Kentucky counties (see Fig. 1) for which agricultural soil surveys have been prepared. Of these surveys some are better than others, and according to the United States Department of Agriculture only five are of sufficient accuracy to be of use to the engineer: 1) Calloway - published in 1937, 2) Fayette - 1931, 3) Graves - 1941, 4) Marshall - 1938, and 5) Mercer - 1930.

If the Kentucky engineer is to have a soils map and survey of the state, it appears that he may have to enter the soil mapping field himself. For areas where pedological maps are not available, the engineer must start his work with the delineation of the different soil areas, using all available mapping methods. Aerial photographs can be of great value in identifying and mapping soil areas, since similar soil patterns can be recognized from their use.

Principles of Air Photo Interpretation

The interpretation of the engineering characteristics of soils from aerial photographs is primarily a matter of deducing the soil properties from clues recorded on the photograph. The analysis and interpretation then depend upon the recognition and proper evaluation of the natural environment of the area.

The use of aerial photographs is based upon three fundamental principles which must be understood if this method of mapping is to be appreciated. First, the aerial photograph is a record of the environmental aspects of an area, and this environment, itself, is the reflection and result of the natural processes at work over the ages. A knowledge of geology, physiography, and pedology is thus of importance in the process of deduction, and makes it possible to trace the probable events responsible for the development of a given soil deposit.

Second, the earth materials can be grouped together to form patterns. These patterns are composed of definite physical elements recognizable in aerial photographs.

The last principle of interpretation is the repetitive nature of soil patterns. Two materials which have developed from similar parent materials under similar conditions of climate, biological activity, topography, and time will have similar engineering characteristics and will exhibit the same air photo patterns. These soil patterns can be used to identify soils and rocks, and to delineate areas of similar materials.

Photo Pattern Elements

Various factors discernible in aerial photographs are analyzed singly and in various combinations, and by deductive reasoning a conclusion is reached involving the characteristics of the soil. The factors which are considered and collectively referred to as the soil pattern are land form, slope, surface drainage, erosion, color tone, vegetation and land use.

Land Form. Of the various factors used by the air photo interpreter the physiography, or land form, is perhaps the most helpful and revealing. Closely associated with the origin of the materials and the subsequent erosional history, its determination establishes the type of parent material in the area. On the basis of this one element, areas of similarity can be delineated and predictions made as to the engineering characteristics of the materials that make up the deposits.

Slope. The factor of ground slope is of importance not only as a constituent of the land form, but also the prevailing slope gives an indication of the materials present. The nature of the slope provides a key to the relative resistance of materials to erosion. Where the weathering progresses at a rapid rate, the sharp edges are worn and the surface slopes assume a rounded, soft appearance. With the more resistant materials, sharper ridges are produced.

Surface Drainage. Precipitation, upon reaching the ground, runs off on the surface or percolates through the soil if not lost by evaporation. The nature and stage of development of the stream and tributary drainage pattern are primarily controlled by the character of the underlying material. Where water is allowed to escape easily by percolation through the soil, the surface runoff will be small and the stream development less than where the soil is impermeable and large amounts of the water run off on the surface. A study of the degree to which the surface drainage pattern has developed can give a fairly reliable clue to the texture of the soil and the development of subsurface drainage.

Erosion. Erosion is closely related to surface runoff. Soil textures and certain profile features largely control the effect this runoff has on the surface features. The gully system, the most discernible of the erosional features on aerial photographs, is of great importance to the engineer.

Semi-granular materials such as silts and sand-clays develop U-shaped gullies (see Fig. 11) in the humid regions. These gullies show a characteristic sharp drop-off from the surface level to the bottom of the gully at the headward end. They are often stubby, extending only a short distance into the uplands.

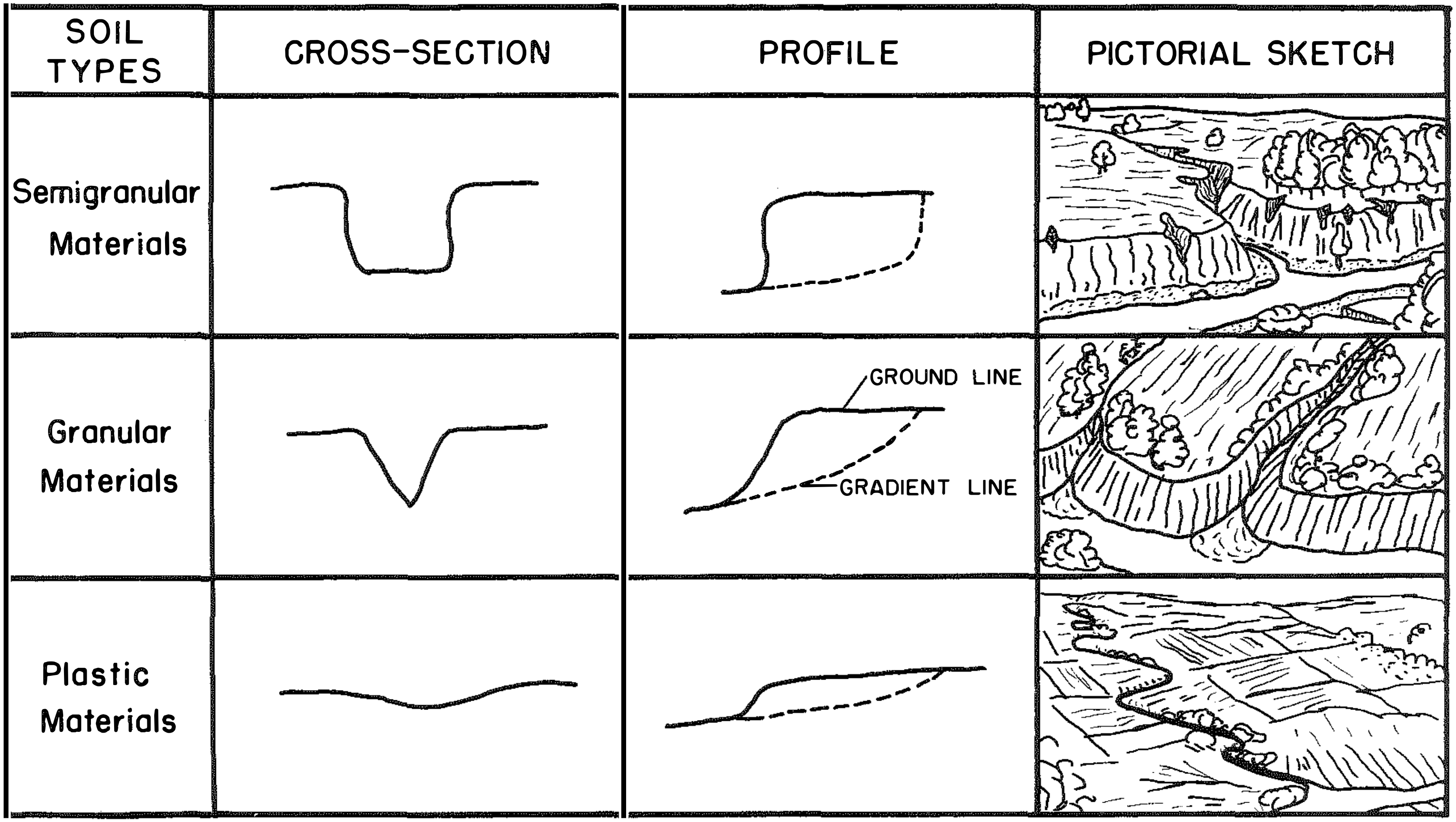


Fig. 11 - Fundamental Gully Shapes.

A gully which exhibits a broad, rounded cross-section is indicative of a deep, uniform profile in a semi-plastic to plastic material. These materials also develop gullies which have a low, uniform gradient and extend for great distances into the uplands.

Granular materials are found in V-shaped gullies. Where these gullies become very broad and shallow, silty or sandy material over a claypan is indicated.

Color Tone. On aerial photographs colors are reproduced as shades of gray, ranging from white to black. The surface color of a soil is a function of its texture and vegetative cover, which in turn are controlled over large areas by climate and locally by the immediate groundwater conditions. Even though the color tones which appear in aerial photographs may often be the result of human activities, such as plowing, this element can give clues as to certain characteristics of the soil.

Vegetation. The vegetative cover recorded in aerial photographs is often very difficult to interpret. The contrasts in vegetation reflect a change in the environmental conditions of plant growth and these variations may be due to changes in soil texture, soil moisture, and topography. However, with local experience, the vegetative cover, both natural and cultural can be used as an indicator of soil characteristics.

Land Use. The use that man has made of an area may often be indicative of soil characteristics. Not only the use but the manner in which the land is prepared for use is of importance. The success of many crops may often be correlated with certain preferred soil conditions. The patterns of contour plowing, terracing, and strip-cropping, and the presence of drainage ditches or furrows indicate soil conditions that may be of value to the engineer.

Limitations of Air Photo Interpretation

To make proper use of air photo interpretation, it is important to recognize the inherent limitations of the technique. It is necessary for the interpreter to learn to recognize conditions beyond which analysis and evaluation become questionable and of little value. The primary limitations are threefold: natural, photographic, and human. The climatic influence, a primary natural limitation, is of importance in the manner in which it affects the soil color tones and the erosional features. In arid regions where the precipitation occurs in the form of flash floods, soft clay shales form gullies with vertical sides. In the humid regions, these same materials produce softly rounded gullies. The season of the year during which the aerial photographs were taken affects the vegetative cover and the immediate groundwater conditions. Many of the elements of the photo pattern may be misleading if the climatic conditions are not properly evaluated and applied.

The view that is presented to the interpreter by the aerial photograph can be influenced by certain features of photography itself. The type of photography, trimetrogon, vertical, or oblique, can affect the technique of interpretation, while the scale of the photograph affects the detail that can be obtained. No single scale is suitable for all purposes; each user must select the scale which gives him the best results. In soil mapping for engineering purposes, scales varying between 1 : 15,000 to 1 : 20,000 have proved generally satisfactory.

The type of film and paper used and the technique of development can effect variations in the color tones of the photographs.

To obtain the maximum benefit from aerial photographs, the interpreter must develop a background in geology, pedology, physiography, ecology, agronomy, climatology, geomorphology, and many other sciences dealing with the surface features of the earth. He should have an understanding of the relationships between the natural features and their engineering significance. The success of air photo interpretation of soils for engineering purposes is largely dependent upon the training and skill of the interpreter and his interest in the work.

Chapter III

METHODS

Since there was available a sufficiently reliable pedological soil survey and map of Fayette County, Kentucky, no actual mapping or delineation of soil areas was required for the present study. The problem became, therefore, one of determining the engineering test constants and giving engineering significance to the pedological soil classifications.

STATISTICAL APPROACH

The first step in the solution of the problem was to answer the question, "How many samples of each horizon of each soil series would be required to give significant results?" To obtain an answer, the question was approached from a statistical viewpoint.

If the thesis that the pedological properties of a given soil are similar wherever the soil is mapped is correct and can be applied to engineering properties also, then the engineering test constants for a given horizon of a given soil should fall within a more or less narrow range determinable from considering test results from a few samples taken at random. This range of values for a given engineering property could be assigned to the particular soil horizon in question, and no matter how many times this horizon is sampled in the many different locations it may be mapped, it could be confidently assumed that the soil is sufficiently uniform for the test value to fall within the range established.

The number of samples required to give such a significant range varies, of course, with the accuracy desired and with the variability of the particular engineering test constant under consideration.

The limits first established for this project were such that the test results on a given sample out of a hundred might deviate from the mean by not more than ten percent. The selection of these particular limits is not to be considered the establishment of a satisfactory range but merely serves as a starting point in determining the number of samples required. Assuming that the engineering test constants fall into a normal distribution about their respective means, this statement of accuracy desired can be represented by the general equation

$$z\sigma' = E\bar{X}' \qquad (1)$$

where $z = \dfrac{X - \bar{X}'}{\sigma'}$,

σ' = standard deviation of the universe,

E = allowable error expressed as a decimal,

$\bar{X}'$ = mean of the universe, and

X = any value of the universe,

The above equation can also be stated in the following terms:

$$z\frac{\sigma}{\sqrt{N}} = E\bar{X} \qquad (2)$$

where σ = standard deviation of a group of samples,

N = number of items in the group of samples,

$\bar{X}$ = mean of a group of samples,

$\sigma' = \sigma/\sqrt{N}$, and

$\bar{X}' \approx \bar{X}$.

In arriving at Equation 2, two assumptions were made. The first was that the engineering test constants for a given soil series assume or are closely approximated by a normal or Gaussian distribution. This is not an unreasonable assumption to make. For example, if the liquid limit were determined for a very large number of samples of the C horizon of the Maury series, as many results would be expected to fall above the mean as would fall below, and these results would be concentrated about the mean. The second of the assumptions was that the mean of the universe was approximated by the mean of a group of samples. This assumption was based on the method of maximum likelihood; that is, the sample statistic is the maximum likelihood estimate of the corresponding universe parameter. This is usually the case and this method is favored by many statisticians (16, page 339).

In Equation 2, letting $z = 2.57$ satisfies the requirement that ninety-nine of one hundred sample results be within the desired range about the mean. Letting $E = 0.10$ establishes this range as plus or minus ten percent of the mean. Using the values of σ and X obtained from a group of samples, the number of samples, N, required can then be calculated.

By restricting, at the beginning, the field sampling and laboratory testing to one soil series it was estimated that three samples from each horizon of each soil series would be needed to meet the requirements established in all cases except that of the plastic limit and plasticity index. The number of samples required for these test values was as high as thirty, seemingly an unreasonably large figure. Calculations indicated that test results from three samples, however, would show only a twenty percent deviation from the mean of the universe for these two test constants. On the basis of this preliminary study, it was decided to attempt to obtain samples of each horizon of each of the soil series from three different locations in the county. In some cases it was found that only two samples were required, and the third was not obtained.

FIELD SAMPLING

The sample sites were located by reference to the pedological soil map and were selected in such a way as to distribute the sites in each soil series over the county. An attempt was made to place the sites near the centers of the large areas of a soil series in order to obtain typical samples and not fall in the transition zones between the series.

No unusual methods of sampling were used. Most of the samples were obtained by a four-inch, Iwan post hole auger (see Fig. 12). This proved to be a quite satisfactory method of obtaining samples except in the very wettest horizons. In these cases, sampling was delayed until the dry season. Samples were obtained to depths of 15 feet by this method. Some samples were also obtained from test pits. In all instances depth, color, texture, moisture conditions, and any other features that might be of interest or use in identification or classification were noted and recorded. A 20- to 30-pound disturbed sample was taken from each of the major horizons at every location and sent to the laboratory for testing.

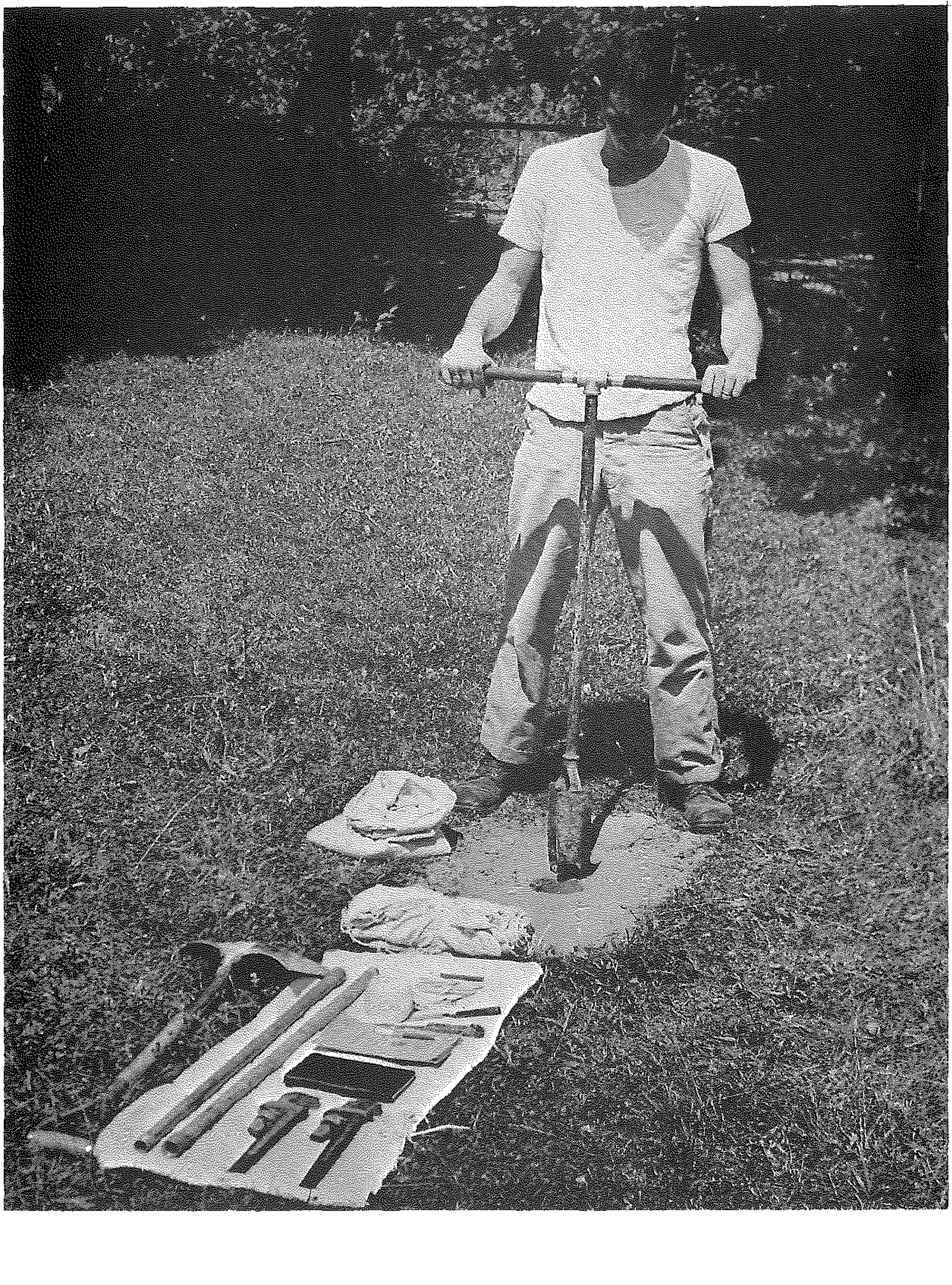


Fig. 12 - Field Sampling Equipment.

LABORATORY TESTING

Once in the laboratory the samples were prepared for the determination of engineering soils constants by the procedure established under ASTM Designation: D 421-39. The soil constants and the methods used for their determination were as follows:

Soil Preparation	ASTM Designation: D 421-39
Mechanical Analysis	ASTM Designation: D 422-39
Liquid Limit	ASTM Designation: D 423-39
Plastic Limit and Plasticity Index	ASTM Designation: D 424-39
Specific Gravity	ASTM Designation: D 854-45T
Moisture-Density Relations	ASTM Designation: D 698-42T
Laboratory CBR	Kentucky Modified Procedure (3, pages 116-119)

A small portion of the minus one micron material was recovered by sedimentation and decantation from 17 selected soil samples. These fractions, representing the near colloid portion of the soil and consisting predominately of clay-type minerals, were leached with acid or otherwise treated to remove x-ray scattering and masking impurities and subsequently conditioned with ethylene glycol preparatory to analysis or identification by x-ray diffraction.

The diffractometer was a Hayes instrument using Cu radiation, 14 centimeter diameter twin cameras, and wedge-type powder mounts. Patterns were recorded on film and the lines measured on a plain vernier-type scale.

ANALYSIS AND PRESENTATION OF DATA

In order to be of value to the engineer, data obtained from an investigation such as this must be presented in a form that is quickly and easily read and understood. In an attempt to satisfy this requirement it was decided to give first a pictorial representation of each soil with a brief, general written description of each of the major horizons (see page 59 and ff.).

This was followed by a table of typical engineering test constants. Rather than give the mean of the test constants as obtained by laboratory testing, it was felt that some significant range should be reported. With this in mind the 90 percent confidence limits for each test constant were calculated and the values recorded in the table. Since the number of samples was small in each case, it was decided to base these confidence limits upon a "t" or "Student's" distribution rather than the normal distribution as was done on page 40. With small sample sizes, the "t" distribution will give better estimates of the universe parameter. The confidence limits were calculated by the procedure given by Duncan (16, pages 345-346) from the limited data obtained during this investigation. They are, however, so determined that regardless of the number of times the particular soil is sampled in the future the engineering test constants will fall within these limits 90 percent of the time. These ranges, then, do have some significance, since a given horizon of a soil may be represented by a more or less narrow range of values for a certain property.

The three classifications (textural, HRB, and group index) given in the table are not subject to the above mentioned analysis, but are the actual designations given each sample. The table is followed by a general discussion of some features and properties of the soil that might affect the engineering treatment of that soil.

This description of each soil -- a pictorial view of the profile with description, a range of values with statistical significance for certain engineering test constants, and a general discussion of other items of interest -- could be used with the agricultural soil survey of the county and with the topographic maps of the area and be of great value to the engineer in planning and carrying to completion the soils portion of his engineering work.

PART II

AN ENGINEERING SOIL SURVEY OF FAYETTE COUNTY

Chapter IV

FAYETTE COUNTY

LOCATION AND CLIMATE

Fayette County, an irregularly shaped area of approximately 280 square miles, lies in the central part of Kentucky within but near the eastern edge of the Inner Blue Grass Region. The county has a maximum north-south length of about 26 miles, and east-west dimension of 20 miles.

The county is situated near the southwestern edge of the Gray-Brown Podzolic Soil Region of the United States where the climate is normally of the warm temperate rainy type, rarely marked by hot dry summers. The mean annual precipitation for the area is approximately 43 inches, nearly half of which falls between March and September. Table 1 gives the more important climatological data for Fayette County as recorded by the United States Weather Bureau Station at Lexington.

PHYSIOGRAPHY

In general, the terrain of Fayette County is typical of the Inner Blue Grass Region, a broad undulating plain with no prominent knobs or ranges of hills. The natural land divisions are used to further describe the area, and each division has distinct soil and physiographic characteristics (see Fig. 13).

The smooth uplands have developed reddish-brown soils derived from phosphatic limestones. The surface drainage of this area is at

Table 1: Normal Monthly, Seasonal, and Annual Temperature and Precipitation at Lexington, Kentucky

	Temperature			Precipitation			
Month	Mean (°F)	Absolute Max. (°F)	Absolute Min. (°F)	Mean (In)	Total Amount Driest Yr. 1930 (In)	Total Amount Wettest Yr. 1935 (In)	Snow Avg. Depth (In)
December	36.0	71	-9	3.61	1.79	3.12	4.0
January	34.1	80	-15	4.45	4.44	5.36	6.2
February	35.3	76	-20	3.20	2.91	2.22	4.5
Winter	35.1	80	-20	11.26	9.14	10.70	14.7
March	44.1	86	-1	4.56	2.54	7.44	3.0
April	54.0	91	15	3.51	0.81	4.36	0.4
May	64.1	96	30	3.66	3.35	10.32	0.1
Spring	54.1	96	-1	11.73	6.70	22.12	3.5
June	73.0	104	40	4.06	1.89	6.55	T*
July	76.4	108	47	4.27	0.45	9.66	T
August	75.0	105	45	3.35	1.69	5.07	T
Summer	74.8	108	40	11.68	4.03	21.28	T
September	69.3	103	32	2.78	2.80	4.46	T
October	57.6	93	21	2.40	0.63	2.81	0.1
November	44.6	80	-3	3.17	1.59	4.39	1.2
Fall	57.2	103	-3	8.35	5.02	11.66	1.3
Year	55.3	108	-20	43.02	24.89	65.76	19.5

* T = Trace, less than 0.01 inch

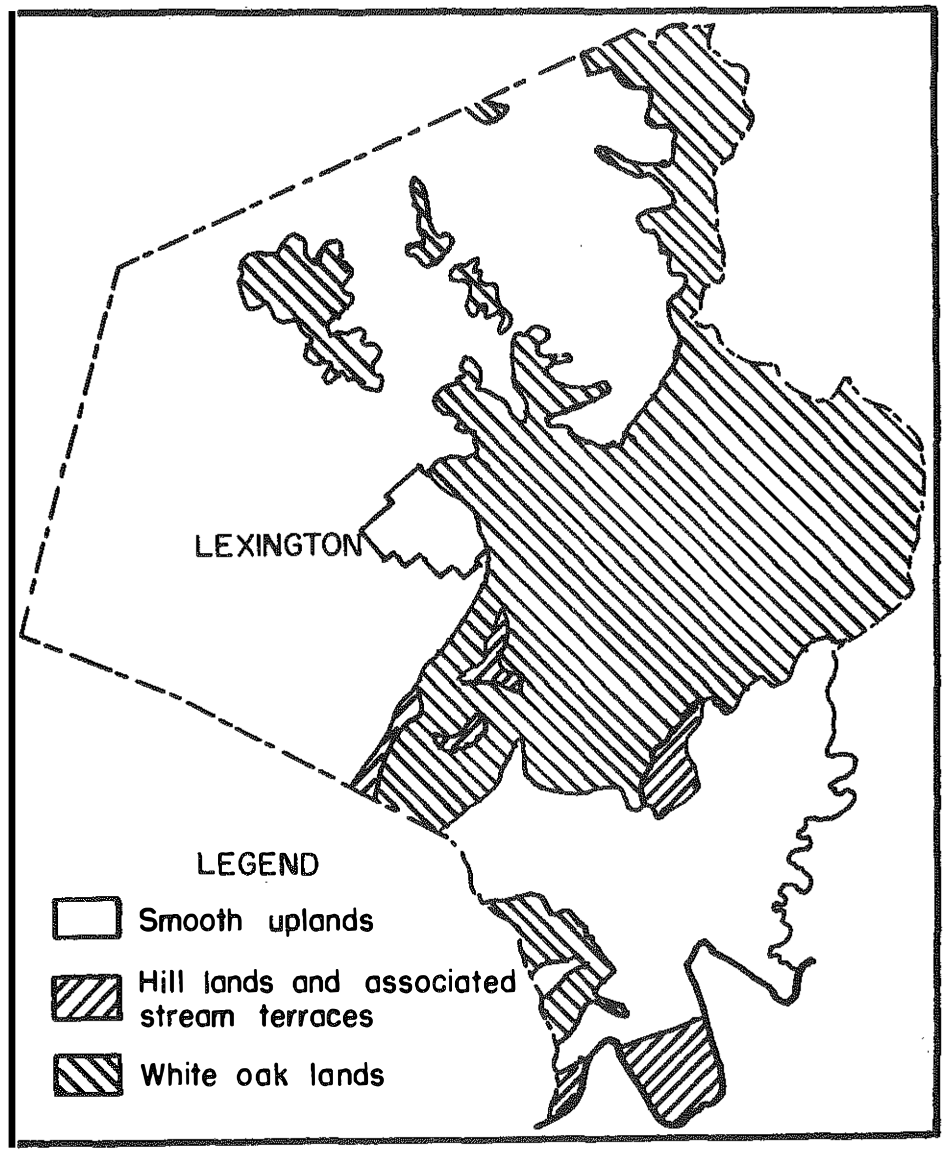


Fig. 13 - Natural Land Divisions of Fayette County, Kentucky.

a minimum since the soil develops a natural structure which allows water to percolate into and through the soil. To the east of Lexington, the white oak lands have developed grayish-brown or yellowish-brown soils. The subsoils are plastic clays which impede internal drainage, thus the surface drainage system is more highly developed than in the uplands. The area of the hill lands is small and represents some outliers of the Outer Blue Grass Region.

The surface of Fayette County can be considered as an old base-level plain which has been uplifted and is now being dissected by the present erosional cycle. This cycle of erosion has developed minor drainage ways through V-shaped valleys. In the western portion of the county these valleys are rather wide and gently sloping. To the east, where dissection has occurred to a greater degree, the valleys are deep and narrow and separated by sharp narrow ridges. The largest surface stream, the Kentucky River, flows along the southeastern boundary of the county in a deeply entrenched U-shaped valley with narrow flood plains between the river channel and the steep valley walls. Boone Creek and other small branches all of which flow into the Kentucky River provide the drainage system for the southeastern part of the county. To the northwest, the surface drainage system consists of North Elkhorn Creek and its tributaries, while the western third of the county is drained by South Elkhorn Creek and Town Branch. Drainage is well developed in the county, there being practically no poorly drained areas. Much of this drainage, however, is through subterranian solution channels, and these, as well as caves and sink-holes, are not uncommon, since many of the constituents of the lime-stones that underlay the county are water soluble.

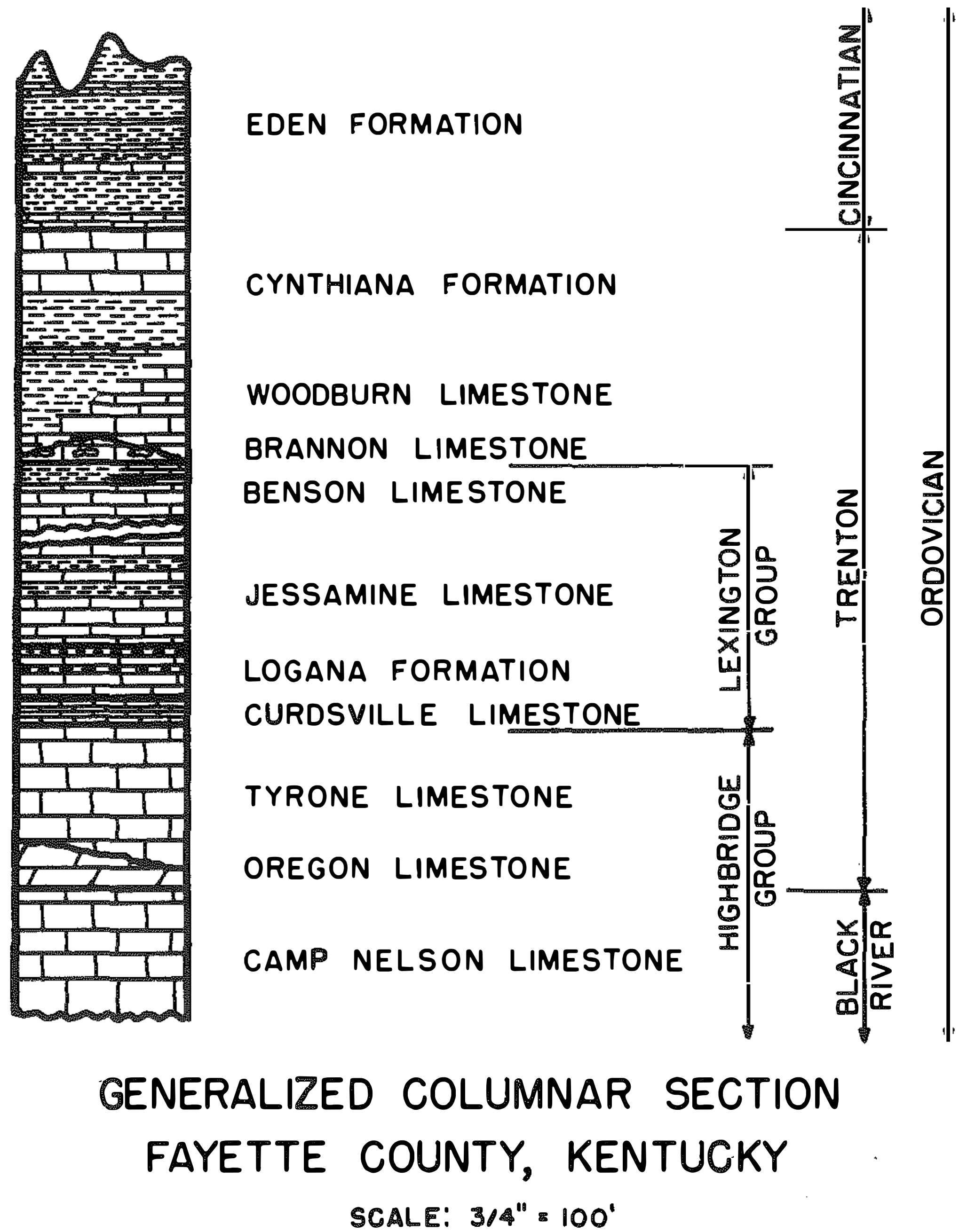


Fig. 15 - Generalized Columnar Section.

strata that outcrop in the county is given in Table 2, and the map in the Appendix shows the areal distribution of these formations.

Table 2. Stratigraphy of Fayette County, Kentucky

Period	Formation	Thickness (Feet)	Description
Cincinnatian (Upper Ordovician)	Eden	150	Blue clay shale with thin lenses of fossiliferous, crystalline limestone of 5 to 10 feet thickness. In the southern portion of Fayette County, the Garrard sandstone member is present in upper part of the formation. This member is a light colored siltstone of 0 to 70 feet thickness.
	Cynthiana	35-140	Medium crystalline limestone, shaly limestone, occasional siliceous mudflow. Fossiliferous.
	Woodburn Limestone	40	Fine-to-coarse-grained crystalline phosphatic limestone. Fresh rock has a light gray granular appearance. Weathers easily to rusty gray appearance with porosity developed by leaching.
	Brannon Limestone	15-20	Fine-grained siliceous bouldery or concretionary limestone with much shale in lower portion. Bouldery appearance appears to be a mudflow structure; at other places an involved cross-bedding. Upon weathering, gives rise to a chert zone.
	Benson Limestone	35-40	Medium to coarsely crystalline limestone in beds several inches to over a foot thick.
	Jessamine Limestone	75-80	Hard gray-blue, thin-to-medium bedded limestone with thin layers of shale.
	Logana	30-35	Thin bedded, fine-grained, gray-blue argillaceous limestone with interbedded shale.
Trenton (Middle Ordovician)	Curdsville Limestone	20	Cherty, coarsely crystalline gray-blue limestone. Medium-to-heavy bedded with some shale partings 6 to 8 inches thick.
	Tyrone Limestone	90	Dense, gray, buff, or cream-colored limestone with beds about 8" thick. Breaks with a conchoidal fracture with small facets of coarsely crystalline calcite exposed. Weathers to a chalky white appearance with the darker calcite facets giving the appearance of "birdseye". Three layers of interbedded bentonite. The first a foot thick, about 10 feet above the Tyrone-Oregon contact. The second, a few inches to a few feet thick, about 10-22 feet below the Tyrone-Curdsville contact. The third occurs at the Tyrone-Curdsville contact.
	Oregon Limestone	15-35	Finely crystalline gray to buff magnesian limestone. Uniformly bedded in layers about 8 inches to a foot thick.
Black River (Lower Ordovician)	Camp Nelson		A limestone with irregular patches of dolomitic material of Oregon type distributed through a dense matrix of the Tyrone type. Weathers to a honeycombed structure.

Chapter V

SOILS OF FAYETTE COUNTY AND THEIR SIGNIFICANCE

The pedological soil map of Fayette County published in 1931 is one of the five highest rated county maps of Kentucky. The soil boundaries of this map are accurately delineated and modern nomenclature is used except in those instances listed in Table 3.

There are 17 soil series and 28 soil types recognized and used in Fayette County. All but three of these series were sampled during the present investigation. The Cumberland, Fairmont, and Guthrie series were the ones not sampled since their combined areas account for only three-tenths of a percent of the total area of the county (see Table 4). Also the location of the sample sites in these soils would have been in doubt since the areas mapped were so small and removed from landmarks. One hundred twenty-six samples from 47 locations were obtained from the remaining 14 soil series. No attempt was made to obtain a sample from each soil type; however, 18 of the 28 types are represented.

Most of the soils of the county are residual, developing for the most part from limestones or calcareous shales. These soils are relatively plastic, as shown by laboratory tests; but nonetheless they are very well drained, there being practically no poorly drained areas in the county. This well drained condition is possible because the joints, cracks and solution channels of the bedrock allow the water to escape quite rapidly and because the soils develop a fragmentary structure which results in a relatively permeable unit. When this natural structure is destroyed in engineering construction, the soils become plastic and react in much the same manner as other clay-like materials.

Table 3. New and Old Pedological Nomenclature for Fayette County, Kentucky

Elk Silt Loam	Elk and Captina Silt Loams
Huntington Silt Loam Colluvial Phase	Manse Silt Loam
Maury Silt Loam, Imperfectly Drained Phase	Donerail Silt Loam
Maury Stony Silty Clay	Stony Lands, Maury Soil Material
Muskingum Loam	Nicholson Loam
Robertsville Silt Loam..................	Guthrie Silt Loam, Depressional Phase

Table 4. Proportionate Extent of the Soils Mapped in Fayette County, Kentucky

Soil Series	Percent of Total Area	Soil Series	Percent of Total Area
Burgin	0.2	Hagerstown	5.2
Captina	0.1	Huntington	4.5
Culleoka	0.3	Loradale	9.9
Cumberland	0.1	Manse	0.8
Donerail	0.5	Maury	55.0
Eden	0.3	Mercer	19.7
Elk	0.2	Nicholson	0.3
Fairmont	0.1	Salvisa	1.3
Guthrie	0.1	Rock Outcrop	1.4

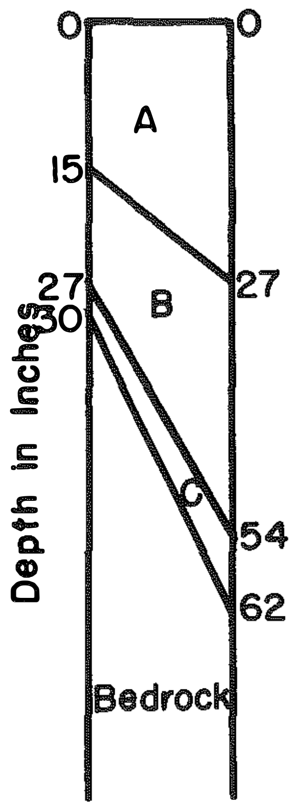
Soils formed in alluvium cover less than six percent of the area of the county. The alluvium has been derived from limestone uplands.

The topography is so gentle over most of the county that in most cases rock excavation is of no concern in highway construction. However, because of the solution channels, bedrock properties do become a point of concern in connection with foundations for large buildings.

The data recorded in tabular form in the Appendix were collected during the sampling and testing of the Fayette County soils. These data have been reviewed and reorganized and are presented in the following few pages in a form suitable for field use.

BURGIN

PROFILE



DESCRIPTION

Horizon A - Very dark brown to nearly black clay silt - friable.

Horizon B - Gray to black, silty clay or clay silt - friable when dry, sticky and plastic when wet - mottled with yellow and reddish brown.

Horizon C - Dark reddish-brown clay silt - plastic - black and gray mottling - a few black concretions.

Bedrock - High-grade to moderately high-grade phosphatic limestone.

BURGIN

Engineering Test Constants	Horizon A	Horizon B	Horizon C
% Sand - 2.0-0.05mm	9-18	20-31	9-78
% Silt - 0.05-0.005mm	61-64	29-70	31-50
% Clay - —0.005mm	20-28	10-41	0-41
% Colloids -—0.001mm	6-10	2-18	0-18
Liquid Limit, %	34-49	35-52	38-54
Plasticity Index, %	9-20	7-23	14-25
Max. Dry Density, PCF	89-101	88-104	103*
Opt. Moisture Content, %	21-27	19-29	23*
Laboratory CBR, %	3-9	--	8*
Textural Classification (Miss. River Comm)	Clay Silt	Clay Silt or Sandy Silt	Clay Silt or Silty Sand
HRB Classification	A-7-6 A-6	A-7-6 A-7-5;A-6	A-7-6
Group Index	8-13	6-13	7-11
Clay Minerals	--	**	**

* Insufficient data to establish a meaningful range.
** No x-ray diffraction pattern.

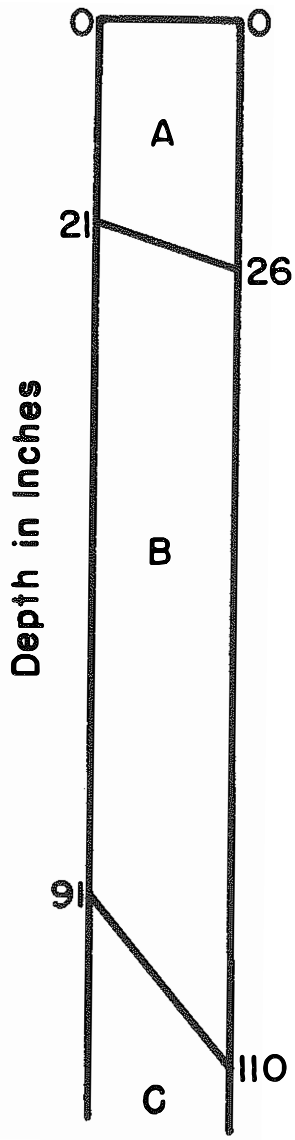
Topography: Intermittent drainage ways or upland depressions. Some of the areas are subject to occasional flooding.

Drainage: Very poorly drained.

Distribution: Located in many drainage ways of limestone areas of Kentucky, Ohio, Tennessee, and Indiana.

CAPTINA

PROFILE



DESCRIPTION

Horizon A - Yellowish-brown to grayish-brown silty clay - friable - contains some dark brown stains.

Horizon B - Brown to yellowish-brown silty clay - compact, friable, slightly plastic in places - yellow and gray mottling - a few dark brown concretions.

Horizon C - Old alluvium consisting of sand, silt, and clay, with beds of gravel in places.

CAPTINA

Engineering Test Constants	Horizon* A	B	C
% Sand - 2.0-0.05mm	10	7	
% Silt - 0.05-0.005mm	48	44	
% Clay - —0.005mm	42	49	No
% Colloids - —0.001mm	15	18	Sample
Liquid Limit, %	43	53	from
Plasticity Index, %	17	27	C
Max. Dry Density, PCF	87	94	Horizon
Opt. Moisture Content, %	24	24	
Laboratory CBR, %	5	7	
Textural Classification (Miss. River Comm)	Silty Clay	Silty Clay	
HRB Classification	A-7-6	A-7-6	
Group Index	11	17	
Clay Minerals	-	Illite	

* Insufficient data to establish a meaningful range.

Topography: Nearly flat stream terraces.

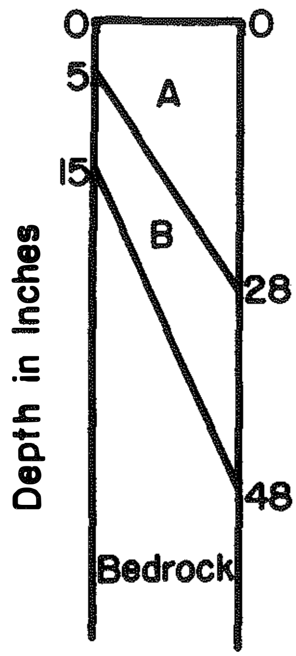
Drainage: Slow.

Distribution: Kentucky, Tennessee, West Virginia, Virginia, Southern Indiana and Ohio.

General: The alluvium from which these soils are derived has been carried from areas of limestone. Thickness of profile is variable, unweathered bedrock occurring at depths of 3 to 15 feet.

CULLEOKA

PROFILE



DESCRIPTION

Horizon A - Dark yellowish-brown silty clay - friable - contains fragments of sandstone or other rock.

Horizon B - Brown to yellowish-brown clay or silty clay - friable when dry, plastic when wet - very few and small black concretions - rock fragments as in A Horizon.

Bedrock - Porous fine-grained sandstone over interstratified soft shales and limestones.

CULLEOKA

Engineering Test Constants	Horizon A	Horizon B
% Sand-2.0-0.05mm	11*	8-12
% Silt - 0.05-0.005mm	54*	17-59
% Clay - —0.005mm	35*	34-72
% Colloids - —0.001mm	12*	18-30
Liquid Limit, %	44*	43*
Plasticity Index, %	26*	20*
Max. Dry Density, PCF	96*	94-104
Opt. Moisture Content, %	23*	21-26
Laboratory CBR, %	6*	0-7
Textural Classification (Miss. River Comm)	Silty Clay	Clay
HRB Classification	A-7-6	A-7-6; A-6
Group Index	15	11-14
Clay Minerals	--	Illite

*Insufficient data to establish a meaningful range.

Topography: Hilly areas on steep slopes divided by narrow ridges.

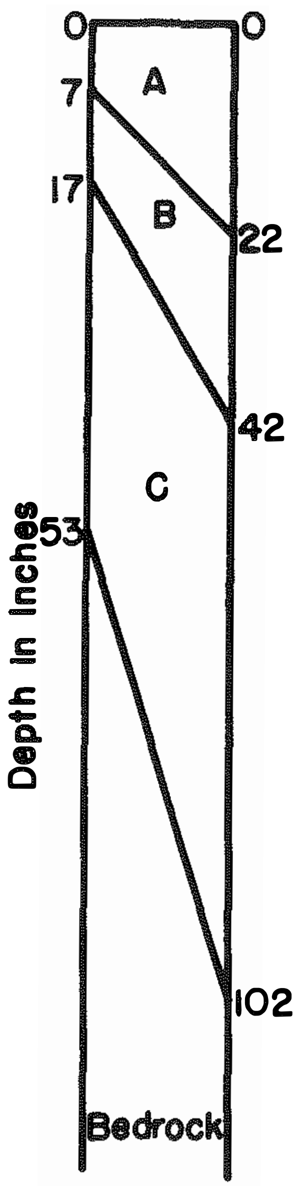
Drainage: Well drained. Runoff medium to rapid, internal drainage moderate.

Distribution: Central Kentucky and Central Basin area of Tennessee. Moderately young soils occurring in association with Eden, Fairmount, Hicks and Inman soils.

General: The underlying geologic stratum is generally different from that giving rise to the major part of the parent material, which has moved downslope to its present position. Many of the areas are covered with stone fragments 6 inches to a foot across.

DONERAIL

PROFILE



DESCRIPTION

Horizon A - Dark brown, sandy silt - firable.

Horizon B - Brown to yellowish-brown clay silt - compact, friable.

Horizon C - Yellowish-brown silty clay - compact - mottled gray and yellow - some small black concretions.

Bedrock - level bedded argillaceous phosphatic limestone.

DONERAIL

Engineering Test Constants	Horizon*		
	A	B	C
% Sand - 2.0-0.05mm	-	16	
% Silt - 0.05-0.005mm	-	57	No
% Clay - –0.005mm	-	27	Sample
% Colloids - –0.001mm	-	10	from
Liquid Limit, %	34	30	C
Plasticity Index, %	11	8	Horizon
Max. Dry Density, PCF	-	106	
Opt. Moisture Content, %	-	18	
Laboratory CBR, %	-	-	
Textural Classification (Miss. River Comm)	-	Clay Silt	
HRB Classification	A-6	A-4	
Group Index	-	8	
Clay Minerals	-	-	

* Insufficient data to establish a meaningful range.

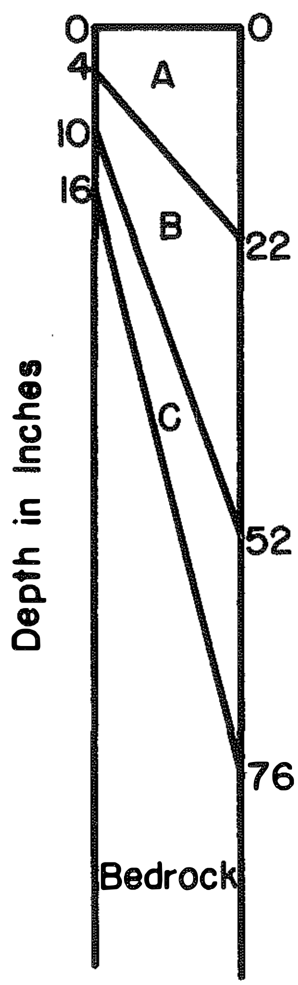
Topography: Nearly level to undulating.

Drainage: Poorly to moderately drained. Surface runoff slow; internal drainage moderate to slow.

Distribution: Occurs in close association with Maury soils in the Inner Blue Grass Region of Kentucky and the Outer Basin Area of Tennessee.

EDEN

PROFILE



DESCRIPTION

Horizon A - Grayish-brown clay or clay silt - Friable when dry, plastic when wet.

Horizon B - Yellow to yellowish-brown clay or silty clay - Mottled gray and black -- a few small black concretions.

Horizon C - Yellowish-Brown to olive brown clay - gray and black mottling - a few black concretions - contains many partially weathered fragments of bedrock.

Bedrock - Shales interstratified with siltstones and thin-bedded limestone.

EDEN

Engineering Test Constants	Horizon A	Horizon B	Horizon C
% Sand - 2.0-0.05mm	14*	0-17	0-12
% Silt - 0.05-0.005mm	43*	34-41	33-37
% Clay - —0.005mm	43*	44-69	56-66
% Colloids -—0.001mm	16*	18-33	25-31
Liquid Limit, %	44-67	43-63	45-65
Plasticity Index, %	11-34	17-33	22-31
Max. Dry Density, PCF	83-94	90-99	93-103
Opt. Moisture Content, %	25-32	23-28	18-26
Laboratory CBR, %	2-6	1-6	1-6
Textural Classification (Miss. River. Comm)	Clay or Clay Silt	Clay or Silty Clay	Clay or Silty Clay
HRB Classification	A-7-5	A-7-6	A-7-6;A-6
Group Index	10-17	13-19	8-18
Clay Minerals	--	--	Illite

* Insufficient data to establish a meaningful range.

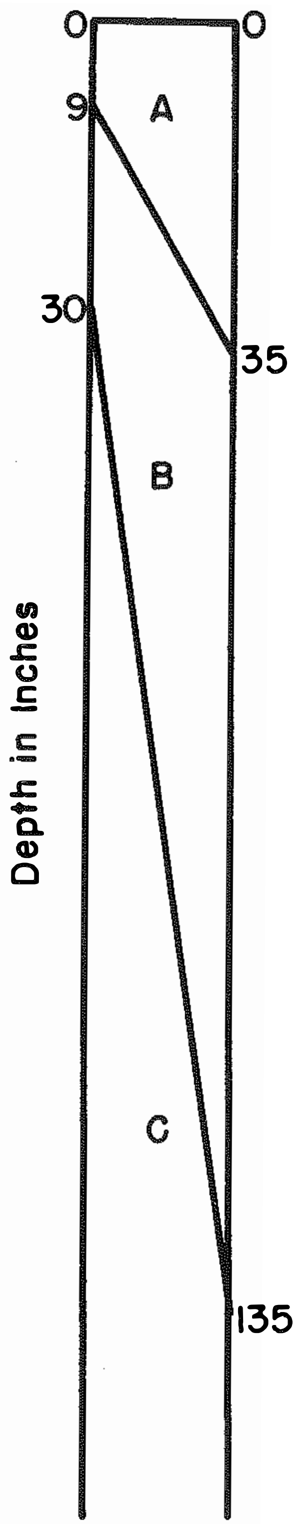
Topography: Moderately steep hillsides and narrow ridges.

Drainage: Well drained. Surface runoff rapid; internal drainage slow.

Distribution: Blue Grass Region of Kentucky and Southern Indiana and Ohio.

ELK

PROFILE



DESCRIPTION

Horizon A - Dark brown to dark reddish-brown sand or silty sand - very friable.

Horizon B - Brown to yellowish-brown silty sand or clay sand - friable to firm when moist, slightly sticky and slightly plastic when wet, slightly hard when dry - few small black concretions - faintly mottled with yellowish-red in lower portion.

Horizon C - Light yellowish-brown silty sand - some gravels in pockets or strata.

ELK

Engineering Test Constants	Horizon A	Horizon B	Horizon C
% Sand - 2.0-0.05mm	63-95	30-80	19-100
% Silt - 0.05-0.005mm	6-15	14-37	15-37
% Clay - -0.005mm	0-23	6-32	0-45
% Colloids - -0.001mm	0-9	2-15	0-9
Liquid Limit, %	NL	NL	NL
Plasticity Index, %	NP	NP	NP
Max. Dry Density, PCF	100-114	99-112	100-115
Opt. Moisture Content, %	13-17	14-18	15-19
Laboratory CBR, %	16*	9-12	8-16
Textural Classification (Miss. River Comm)	Sand or Silty Sand	Silty Sand or Clay	Silty Sand
HRB Classification	A-2-4;A-4	A-4	A-4
Group Index	0-8	2-7	2-3
Clay Minerals	--	--	Kaolinite and Illite

*Insufficient data to establish a meaningful range.

Topography: Level to gently sloping stream terraces of old alluvium.

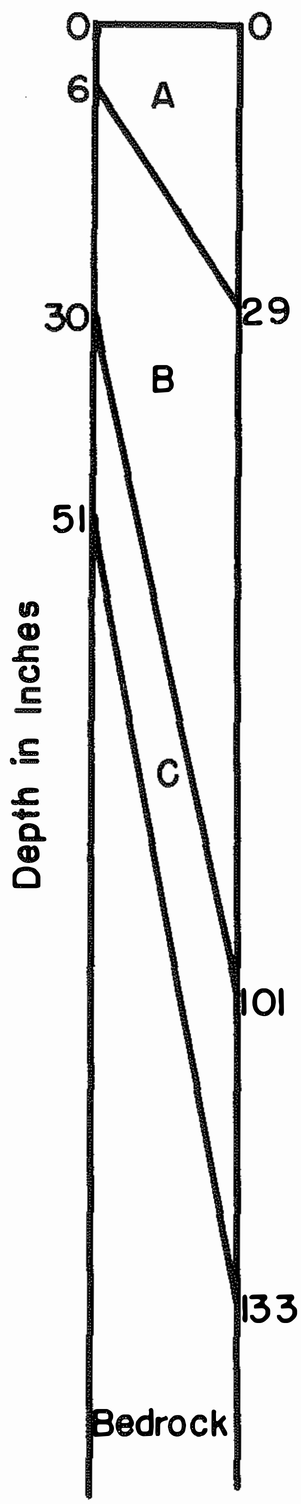
Drainage: Well drained. Medium runoff and internal drainage.

Distribution: Limestone areas of Kentucky, Tennessee, Pennsylvania, Maryland, Virginia, West Virginia, Arkansas, and Missouri. Member of the Elk-Captina-Taft-Robertsville-Bagnell Catena.

General: These alluvial deposits consist of sediments washed from soils developed in residuum, predominately of limestone. The thickness of the alluvium ranges from about 3 to 25 feet, thus the profile varies considerably in thickness. Pockets or strata of gravel may occur at depths of 4 or 5 feet, or may be distributed throughout the profile.

HAGERSTOWN

PROFILE



DESCRIPTION

Horizon A - Grayish-brown or dark brown silty clay or clay silt - friable.

Horizon B - Light brown to reddish-brown silty clay or clay silt - friable when dry, plastic and sticky when wet - common black concretions.

Horizon C - Light reddish-brown to yellowish-brown clay or silty clay - firm and slightly compact, brittle when damp.

Bedrock - Massive, hard limestone.

HAGERSTOWN

Engineering Test Constants	Horizon A	Horizon B	Horizon C
% Sand - 2.0-0.05mm	5-20	13-20	9-34
% Silt - 0.05-0.005mm	50-59	31-67	30-33
% Clay - -0.005mm	26-40	19-50	34-60
% Colloids --0.001mm	7-19	6-24	17-35
Liquid Limit, %	32-39	36-45	40-56
Plasticity Index, %	10-14	16-20	14-28
Max. Dry Density, PCF	100-102	97-104	87-104
Opt. Moisture Content, %	20-24	20-26	22-30
Laboratory CBR, %	3-12	5-12	2-3
Textural Classification (Miss. River Comm)	Silty Clay or Clay Silt	Silty Clay or Clay Silt	Clay or Silty Clay
HRB Classification	A-6	A-7-6;A-6	A-7-6;A-6
Group Index	8-9	11-12	8-18
Clay Minerals	--	--	Illite

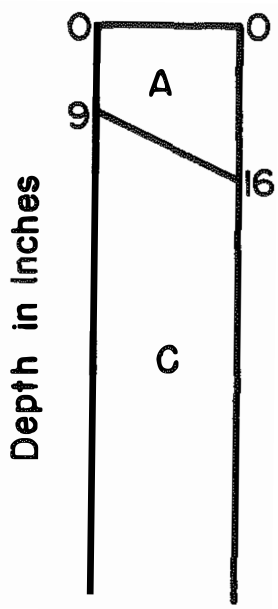
Topography: Level to gently rolling terrain.

Drainage: Well drained. Surface and internal drainage good.

Distribution: Limestone areas in Pennsylvania, Maryland, West Virginia, Virginia, Kentucky, and Indiana.

HUNTINGTON

PROFILE



DESCRIPTION

Horizon A - Dark brown to dark yellowish-brown silty clay or clay silt - very friable.

Horizon C - Dark brown to dark grayish-brown silty sand or clay sand - friable - mottled light brownish gray to very dark brown.

HUNTINGTON

Engineering Test Constants	Horizon A	Horizon C
% Sand - 2.0-0.05mm	4-20	0-86
% Silt - 0.05-0.005mm	49-71	7-69
% Clay - —0.005mm	9-47	6-42
% Colloids - —0.001mm	9-12	6-11
Liquid Limit, %	32-39	32-51
Plasticity Index, %	9-10	12-17
Max. Dry Density, PCF	94*	102-104
Opt. Moisture Content, %	24*	20-26
Laboratory CBR, %	2-7	-
Textural Classification (Miss. River Comm)	Silty Clay or Clay Silt	Silty Sand or Clay Sand
HRB Classification	A-4	A-7-5; A-7-6
Group Index	8	3-10
Clay Minerals	-	**

* Insufficient data to establish a meaningful range.

** No x-ray diffraction pattern.

Topography: Nearly level to sloping first bottoms. Gradients usually range from 1 to 3 percent.

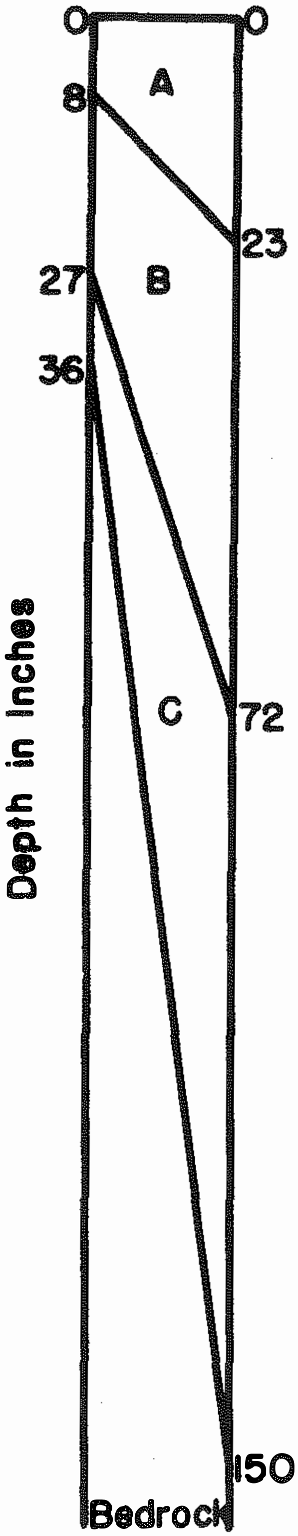
Drainage: Well drained but subject to occasional overflow.

Distribution: Well drained member of the Huntington-Lindside-Newark-Melvin-Dunning Catena in Pennsylvania, Maryland, West Virginia, Virginia, Indiana, Ohio, Kentucky, Tennessee, Georgia, Alabama, Arkansas, and Missouri.

General: These soils are composed of young sediments derived largely from limestone upland, with some components of sandstone and shale.

LORADALE

PROFILE



DESCRIPTION

Horizon A - Dark grayish-brown to dark reddish-brown clay silt or, occasionally, silty clay - friable.

Horizon B - Dark brown to reddish-brown silty clay or clay silt - sticky and plastic when wet, firm when moist, hard when dry - a few small round dark concretions near top of horizon increasing to many small and medium round concretions, giving way to abundant splotches of soft irregularly shaped concretionary material mottled yellowish-brown to brownish-gray in lower portion of horizon.

Horizon C - Light olive brown to yellowish-brown clay - very sticky and very plastic when wet, very firm when moist, very hard when dry - a few small round dark concretions and some soft, black, irregularly shaped concretionary material - mottles of brownish-gray or light olive gray common.

Bedrock - Interbedded high-grade, medium phosphatic limestones and calcareous shales.

LORADALE

Engineering Test Constants	Horizon A	Horizon B	Horizon C
% Sand - 2.0-0.05mm	9-15	17-34	14-24
% Silt - 0.05-0.005mm	56-63	30-48	26-29
% Clay --0.005mm	25-32	31-41	49-58
% Colloids --0.001mm	7-11	12-19	31-35
Liquid Limit, %	33-39	33-41	51-59
Plasticity Index, %	11-15	12-21	18-32
Max. Dry Density, PCF	97-104	96-106	84-91
Opt. Moisture Content, %	20-22	21-25	28-33
Laboratory CBR, %	5-10	2-18	4-8
Textural Classification (Miss. River Comm)	Clay Silt or Silty Clay	Silty Clay or Clay Silt	Clay
HRB Classification	A-6; A-7-6	A-6; A-7-6 A-7-5	A-7-5 A-7-6
Group Index	8-10	8-14	14-20
Clay Minerals	--	--	Illite

Topography: Moderately rolling topography exhibiting in some areas a slight Karst configuration. Soil develops on gently sloping ridge tops and hillsides with slopes of 3 to 15 percent, occurring most commonly on the gentler slopes.

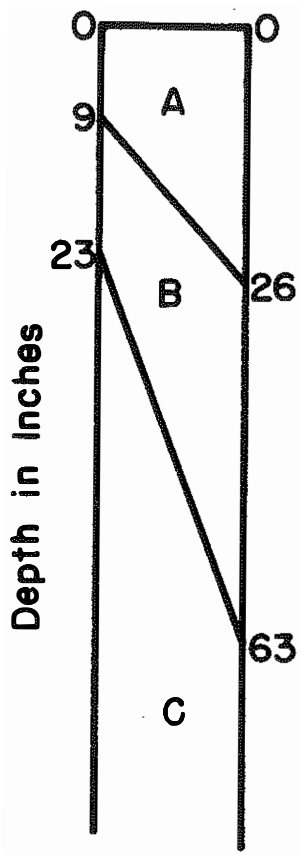
Drainage: Well drained; runoff medium to rapid; internal drainage medium.

Distribution: Extensive in the Inner Blue Grass Region of Kentucky and the Central Basin Area of Tennessee. Closely associated with Mercer soils.

MANSE

PROFILE

DESCRIPTION



Horizon A - Dark brown clay silt - friable.

Horizon B - Brown to yellowish-brown sandy silt - friable - common small black concretions and splotches.

Horizon C - Olive brown to black clay silt or sandy silt - firm and friable - many small black concretions.

MANSE

Engineering Test Constants	Horizon* A	B	C
% Sand - 2.0-0.05mm	19	7	23
% Silt - 0.05-0.005mm	61	74	57
% Clay - -0.005mm	20	19	20
% Colloids - -0.001mm	3	5	8
Liquid Limit, %	37	38	36
Plasticity Index, %	3	13	6
Max. Dry Density, PCF	88	96	94
Opt. Moisture Content, %	28	23	25
Laboratory CBR, %	5	5	-
Textural Classification (Miss. River Comm)	Clay Silt	Sandy Silt	Sandy Silt or Clay Silt
HRB Classification	A-4	A-6	A-4
Group Index	8	9	8
Clay Minerals	-	-	**

* Insufficient data to establish meaningful ranges.
** No x-ray diffraction pattern.

Topography: Gentle toe-slopes and alluvial fans with gradients of about 3 to 8 percent.

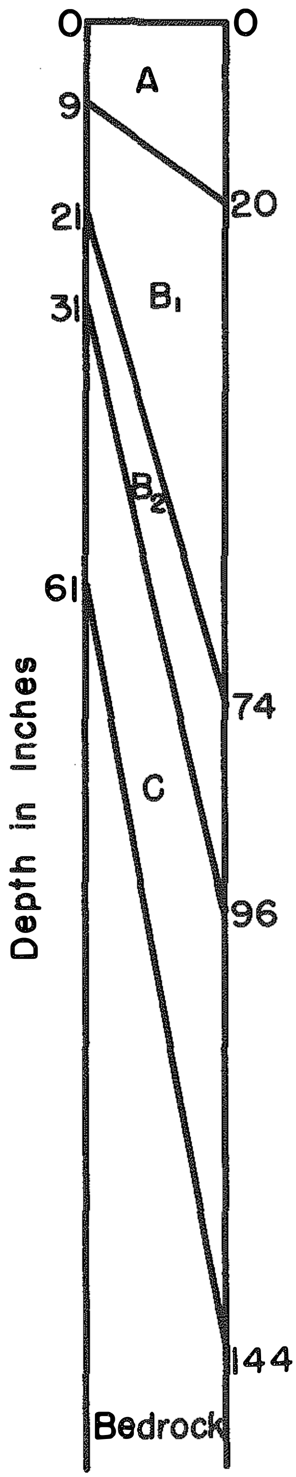
Drainage: Well drained to moderately well drained. Runoff and internal drainage are medium.

Distribution: The Blue Grass Region of Kentucky and the Central Basin of Tennessee.

General: These soils are developed in local alluvium washed from upland soils of limestone origin. Depth to limestone bedrock may be several feet. In some places this profile rests on a buried B horizon.

MAURY

PROFILE



DESCRIPTION

Horizon A - Dark brown or dark reddish-brown silty clay or clay silt -- very friable -- a few very small, almost black, round concretions.

Horizon B_1 - Dark reddish-brown to reddish-brown silty clay or clay silt -- friable in top portion becoming sticky and slightly plastic when wet in lower portion, firm when moist, hard when dry -- small, black concretions that increase in number with depth.

Horison B_2 - Yellowish-red, slightly variegated with brown, silty clay or clay -- sticky and plastic when wet, firm when moist, hard when dry -- many small, round, black concretions -- some soft, irregularly shaped concretionary splotches -- a few weathered fragments of chert and limestone in the power portion.

Horizon C - Yellowish-red to brown silty clay or clay, mottled with dark brown and yellowish-brown -- sticky and plastic when wet, firm when moist, very hard when dry -- few to common small, black concretions and soft, irregularly shaped concretionary splotches -- many weathered fragments of chert and limestone that increase in number with depth.

Bedrock - Highgrade phosphatic limestone.

MAURY

Engineering Test Constants	Horizon A	B1	B2	C
% Sand - 2.0-0.05mm	5-14	12-20	10-24	12-25
% Silt - 0.05-0.005mm	55-59	44-53	22-45	25-47
% Clay - -0.005mm	29-38	28-40	35-64	26-65
% Colloids - -0.001mm	9-14	10-18	18-45	8-43
Liquid Limit, %	35-38	38-41	47-54	45-61
Plasticity Index, %	11-13	15-19	19-23	18-32
Max. Dry Density, PCF	93-104	98-103	92-98	90-99
Opt. Moisture Content, %	20-25	21-23	24-29	24-33
Laboratory CBR, %	3-17	7-11	1-13	3*
Textural Classification (Miss. River Comm)	Silty Clay Clay Silt	Silty Clay Clay Silt	Silty Clay Clay	Silty Clay Clay
HRB Classification	A-6 A-7-6	A-6 A-7-6	A-7-6 A-7-5	A-7-6 A-7-5
Group Index	8-10	8-11	12-16	12-20
Clay Minerals	--	--	--	Illite

* Insufficient data to establish a meaningful range.

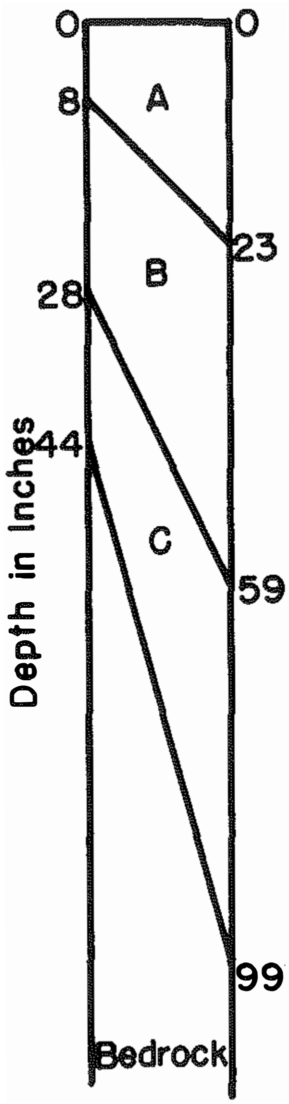
Topography: Gently to steeply sloping terrain with gradients generally 2 to 12 percent and some as great as 20 percent. Many areas have Karst topography.

Drainage: Well drained. Runoff and internal drainage are medium.

Distribution: The most extensive of the highly phosphatic soils in the Inner Blue Grass Region of Kentucky and the Outer Basin Area of Tennessee. Found in close geopraphic association with soils of the McAfee, Braxton, Salvisa, Hagerstown, Loradale, Hampshire, Culleoka, Inman, and Hicks series.

MERCER

PROFILE



DESCRIPTION

Horizon A - Dark grayish-brown to dark yellowish-brown clay silt, or, occasionally, silty clay - friable.

Horizon B - Yellowish-brown silty clay - friable when moist increasing in firmness until becoming brittle with depth. Sticky when wet - a few small round black concretions increasing in number and then gradually giving way to very abundant soft black, irregularly shaped concretionary splotches with greater depth - strong brown to light-brownish-gray distinct mottling near bottom of horizon.

Horizon C - Strong brown to light olive-gray clay or silty clay - mottled with yellowish-brown - firm when moist, sticky and very plastic when wet, very hard when dry - a few small round black concretions.

Bedrock - High-grade, medium phosphatic limestones with strata of calcareous shales.

MERCER

Engineering Test Constants	Horizon A	Horizon B	Horizon C
% Sand - 2.0-0.05mm	8-23	14-22	18-37
% Silt - 0.05-0.005mm	52-63	37-55	32-36
% Clay - -0.005mm	21-32	31-42	23-61
% Colloids - -0.001mm	5-9	12-18	11-36
Liquid Limit, %	36-42	36-41	28-56
Plasticity Index, %	8-13	14-19	3-35
Max. Dry Density, PCF	88-108	99-108	93-109
Opt. Moisture Content, %	16-28	18-23	20-26
Laboratory CBR, %	2-11	3-18	9*
Textural Classification (Miss. River Comm)	Clay Silt or Silty Clay	Silty Clay	Clay or Silty Clay
HRB Classification	A-4;A-6 A-7-6	A-6 A-7-6	A-6 A-7-6
Group Index	8-10	9-11	11-18
Clay Minerals	--	--	Illite, Kaolinite & Montmorillonite(Nontronite)

* Insufficient data to establish a meaningful range.

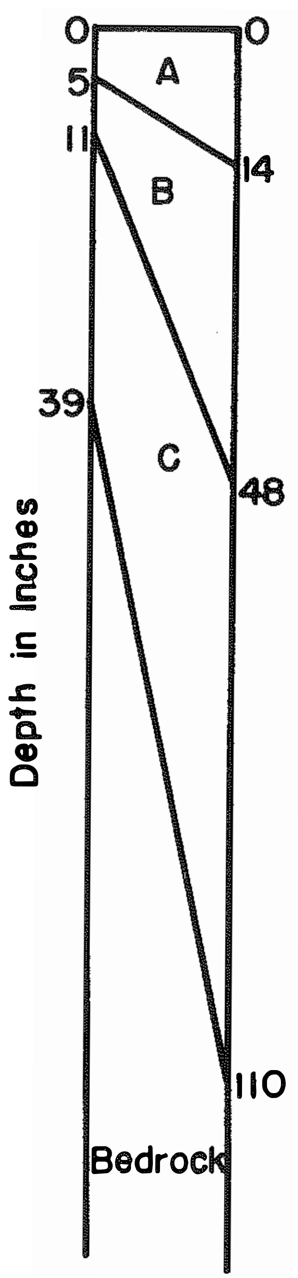
Topography: Nearly level to slightly sloping ridge tops with gradient usually from about 1 to 7 percent, sometimes as high as 10 percent.

Drainage: Moderately well drained. Runoff is slow to medium, internal drainage is slow. Fragipans often encountered at depths of 15 to 30 inches and range in thickness of about 10 to 20 inches.

Distribution: Fairly extensive soils of the Inner Blue Grass Region of Kentucky and the Outer Basin of Tennessee. Found in close geographic association with the Hampshire, Inman, Loradale, Hagerstown, Maury and Eden series.

NICHOLSON

PROFILE



DESCRIPTION

Horizon A - Brown clay silt, or, occasionally, silty clay - very friable.

Horizon B - Dark yellowish-brown or brown silty clay or, occasionally, clay - friable in top portion becoming firm, compact, and brittle when moist, sticky when wet, and very hard when dry in the lower portion - a few small round black concretions which increase in number with depth - pale brown or light brownish-gray mottling.

Horizon C - Yellowish-brown silty clay with many mottles of light olive-brown or light gray - very firm when moist, sticky and plastic when wet, very hard when dry.

Bedrock - Siltstone.

NICHOLSON

Engineering Test Constants	Horizon A	B	C
% Sand - 2.0-0.05mm	9-19	8-18	7-35
% Silt - 0.05-0.005mm	48-66	40-51	40-43
% Clay --0.005mm	17-43	32-52	25-41
% Colloids --0.001mm	5-18	13-23	16-28
Liquid Limit, %	24-45	31-47	36-41
Plasticity Index, %	3-18	11-21	5-24
Max. Dry Density, PCF	95*	97-104	94*
Opt. Moisture Content, %	24*	20-24	26*
Laboratory CBR, %	7*	6*	7*
Textural Classification (Miss. River Comm)	Clay Silt or Silty Clay	Silty Clay or Clay	Silty Clay
HRB Classification	A-4 A-7-6; A-6	A-6 A-7-6	A-6
Group Index	8-13	9-16	9-10
Clay Minerals	--	--	Illite

*Insufficient data to establish a meaningful range.

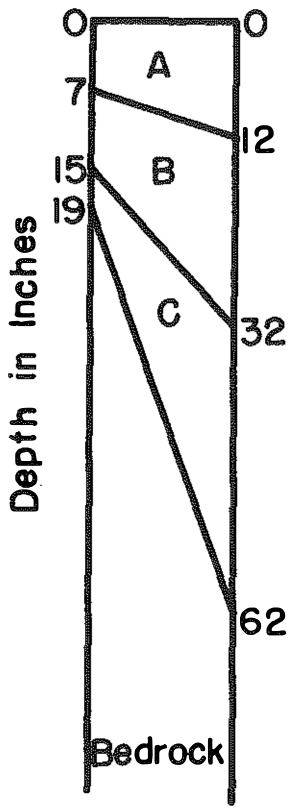
Topography: Soils occupy broad divides and narrow ridgetops above steep slopes and with gradients of 3 to 10 percent.

Drainage: Well drained to moderately well drained, medium runoff, permeability of upper solum is moderate, of lower solum slow. Depth to fragipan ranges from about 28 to 48 inches, with thickness of fragipan considerably variable.

Distribution: In extensive soils in the Outer Blue Grass and the Knobs of Kentucky. Occupies relatively gentle slopes above steeper slopes of Eden, Culleoka, and Fairmount soils.

SALVISA

PROFILE



DESCRIPTION

Horizon A - Very dark grayish brown clay silt - friable to firm.

Horizon B - Brown to yellowish-brown silty clay or clay silt - very firm when moist, sticky and slightly plastic when wet, very hard when dry - a few small black concretions.

Horizon C - Dark brown to yellowish-brown silty clay or clay silt - very firm when moist, sticky and plastic when wet, very hard when dry - some distinct mottling - few to common black concretions.

Bedrock - Hard, thin bedded limestone with interbedding of gray calcareous shale.

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Engineering Test Constants	Horizon A	Horizon B	Horizon C
% Sand - 2.0-0.05mm	15-26	7-20	12-20
% Silt- 0.05-0.005mm	52-63	52-61	31-63
% Clay - —0.005mm	12-33	28-32	23-52
% Colloids - —0.001mm	5-8	8-11	9-28
Liquid Limit, %	28-38	28-47	24-69
Plasticity Index, %	5-11	10-17	8-37
Max. Dry Density, PCF	101*	92-105	80-109
Opt. Moisture Content, %	22*	20-26	19-32
Laboratory CBR, %	7*	4-17	1-9
Textural Classification (Miss. River Comm)	Clay Silt	Silty Clay or Clay Silt	Silty Clay or Clay Silt
HRB Classification	A-4;A-6	A-6;A-7-6	A-7-6;A-6
Group Index	6-8	8-11	11-20
Clay Minerals	--	--	Illite

* Insufficient data to establish a meaningful range.

Topography: Sloping to steep hillsides with gradients of 6 to 30 percent.

Drainage: Well drained. Rapid surface runoff, moderately slow internal drainage.

Distribution: Not very extensive soils of the Inner Blue Grass Region of Kentucky and the Central Basin of Tennessee. Closely associated with the Maury, Hampshire, Loradale, and Hagerstown soils.

General: Depth to bedrock ranges from a few inches to about 5 feet, erosion having seriously truncated the profile in some places. Outcrops of thin, hard limestone ledges are characteristic, with many areas covered with large, plate-shaped stones.

Chapter VI

RESULTS AND RECOMMENDATIONS

Insofar as the Fayette County survey was intended to serve more as a pilot study than as a search for particular information, its primary "results" could only be in its over-all success, demonstrating the practicability of its approach to the engineering soils problem. This is not to say that the soils series descriptions determined in the study and presented in Chapter V are not of importance and value; but that the real intent was to determine whether the proposed method would be feasible. It is felt that the study was quite successful, and that it indicates the potential value of the methods in carrying out the making of a complete series of engineering soil surveys for the entire state. It is felt also that much was accomplished in solving many of the problems of materials, equipment and procedures that such work would entail.

It must be admitted that part of the success of the Fayette County project was a consequence of the accuracy and ready availability of a pedological soils map, which by no means would be available for all counties in the State. This circumstance, however, would not render the method useless in counties where such maps are not available; there would be several ways of remedying this, either through the use of expertly interpreted air photos or through the making of other suitable maps or classifications.

The study presents an engineering description for 14 of the soil series mapped in Fayette County, Kentucky, representing a beginning for a complete engineering soil survey for the state, in which each of the 208 soil series used in Kentucky would have a description similar to those given herein.

A survey program for the entire state might follow any one, or a combination, of three alternatives. First, the engineering significance of pedological soil classifications might be determined on a county-by-county basis similar to that used for the present investigation. This method, however, could be used only for those counties for which accurate pedological maps have been prepared. Thus it is rather limited since so few counties in Kentucky are mapped and since mapping is progressing so slowly. But when it is possible to use this approach it will provide a soil survey complete with engineering soil descriptions as well as areal distribution.

A second approach to the survey program might be through sampling each of the soil series and determining their engineering properties. This method can not alone furnish a complete survey, since the areal distributions of the soils will be unknown until pedological maps become available. Limited pedological surveys could be made for individual projects and the engineering soil descriptions applied. This approach will probably prove to be the most profitable on a long range program.

The last approach would be to combine the second method with a mapping program whereby the engineer would actually map or delineate soil areas and then determine their engineering signficance. This, of course, presents a problem in that few engineers in Kentucky would be prepared to do such mapping. Further work in correlating air photo interpretation with the predominately residual soil patterns of Kentucky is indicated, in order that the air photo technique might be used as an aid in soil mapping.

APPENDICES

TABLE 5. SUMMARY OF FIELD DATA

Site No.	Location Description	Date Sampled	Slope Class	Water Table Depth	Solid Rock Depth	Pedological Soil Type	Sample No.	Field Description	Color	Horizon Depth
						BURGIN SERIES				
34-9	100' S of Southern By-Pass, E of RR in a small draw.	22 Feb 55	0-4%	0'-6"	—	Burgin Silty Clay Loam.	9A	—	—	0"-18"
							9B	—	—	18" ≁
34-35	110' S of Southern By-Pass, 25' E of the draw to the E of the RR.	19 May 56	0-4%	—	—	Burgin Silty Clay Loam.	35A	Friable silty clay loam.	Dark Brown	—
34-46	40' E of Russell Cave Road, 1.2 mi. S of Ironworks Rd.	20 Sept 56	0-4%	5'-0"	6'-6" ≁	Burgin Silty Clay Loam.	46A	Dense, very friable silt loam.	Dark Brown to black.	0"-27"
							46B	Slightly friable silt loam, plastic near bottom, reddish-brown mottling.	Very dark brown to black.	27"-54"
							46C	Plastic clay loam, black and gray mottling, few small black concretions.	Reddish-brown.	54"-78" ≁
34-47	40' E of centerline of Redd Rd, 0.1 mi. S of Old Frankfort Pike.	20 Sept 56	0-4%	—	5'-4" ≁	Burgin Silty Clay Loam.	47A	Friable Silt Clay.	Dark Brown	0"-23"
							47B	Friable Silt Loam, reddish-brown, mottling near the bottom.	Black	23" -37"
							47C	Clay Loam, slightly plastic, common small black and rust concretions, rock fragments ¼" dia.	Reddish-brown.	37" -60" ≁
						CAPTINA SERIES				
34-32	30' SW of centerline of Dry Branch Rd., 2.3 mi from Jacks Creek Rd.	14 May 56	0-4%	None	5'-8"	Captina Silt Loam.	32A	Friable but very firm silt loam.	Grayish-brown.	0" - 18"
							32B	Plastic, moderately heavy silty clay loam, occasional black and dark gray mottling, encountered gray-white Ss fragments at 39."	Brown, slight reddish tinge.	18"-68"
						CULLEOKA SERIES				
34-27	60' E of Jacks Creek Rd, 1.0 mi. SE of Dry Branch Rd.	12 May 56	16-55%	None	3'- 9"	Culleoka Silt Loam	27A	Friable silt loam.	Slight yellowish-brown.	0" - 28"
							27B	Plastic clay loam, very few, and small black concretions.	Bright yellowish-brown.	28" - 45"
34-29	55' E of Jacks Creek Rd, 2.4 mi. SE of Dry Branch Rd.	12 May 56	4-16%	None	1'- 2"	Culleoka Silt Loam.	29A	Tough silt loam. No sample.	Grayish-brown	0" - 2"
							29B	Tough, dense, silty clay loam.	Yellowish-brown	2" - 14"
						DONERAIL SERIES				
34-8	100' S of Southern By-Pass, 100' W of RR.	1 Mar 55	0-4%	2'-8"	—	Donerail Silt Loam.	8A	—	—	0" - 13"
							8B	—	—	13" ≁
						EDEN SERIES				
34-3	20' S of Mt. Tabor Rd, 2.1 mi. E of Tates Creek Rd.	14 Mar 56	4-16%	None	5' -2"	Eden Silty Clay	3A	Heavy silty clay loam, mottled in lower portion.	Grayish-brown	0" - 22"
							3B	Heavy, firm silty clay, black and brown mottling.	Yellowish-brown	22" - 38"
							3C	Firm, but friable silty clay loam.	Yellowish-brown	38" - 62"
34-31	50' E of Dry Branch Rd, 1.0 mi. S of Jacks Creek Rd.	14 May 56	4-16%	None	1' -7"	Eden Silty Clay	31A	Slightly friable, heavy silty clay loam.	Grayish-brown	0" - 7"
							31B	Heavy silty clay, occasional black mottling.	Yellowish-brown	7" - 13"
							31C	Heavy silty clay, occasional black mottling.	Yellowish-brown	13" - 19"
34-36	40' S of Armstrong Mill Rd, 1.4 mi. E of Tates Creek Rd.	19 May 56	4-16%	None	2' -10"	Eden Silty Clay	36A	Friable silt loam	Brown	0" - 8"
							36B	Slightly friable, firm silty clay, few black concretions.	Reddish-brown, yellowish tinge.	8" - 26"
							36C	Slightly friable, firm silty clay, gray mottling few black concretions.	Yellowish-brown	26" - 34"

TABLE 5 (CONTINUED)

Site No	Location Description	Date Sampled	Slope Class	Water Table Depth	Solid Rock Depth	Pedological Soil Type	Sample No.	Field Description	Color	Horizon Depth.
						ELK SERIES				
34-28	50' E of Jacks Creek Rd, 1000' N of Kentucky River	12 May 56	0-4%	--	8' -11" +	Elk Silt Loam	28A	Friable sandy silt loam.	Brown, slight reddish tinge.	0" - 9"
							28B	Friable sandy clay loam	Reddish-brown	9" - 107"+
34-33	Dry Branch Rd, 100' N of Kentucky River, 2.0 mi. from Jacks Creek Rd. Sample from face of cut.	14 May 56	0-4%	--	14'-6" +	Elk Silt Loam	33A	Sandy loam, grayish when dry.	Reddish-brown	0" - 22"
							33B	Sandy clay loam, silver gray streaks.	Reddish-brown	22" -152"
							33C	Sandy silt loam, less binder than in B Horizon.	Reddish-brown, slight yellowish tinge.	152" -174"
34-40	35' N of Kentucky River, 0.3 mi. W of Jacks Creek Rd.	4 June 56	0-4%	--	10' -2" +	Elk Silt Loam	40A	Sandy loam	Light reddish-brown	0" - 42"
							40B	Friable sandy silt loam	Dark Brown	42" - 78"
							40C	Sandy silt loam, amount of binder increased with depth.	Dark reddish-brown	78" - 122" +
						HAGERSTOWN SERIES				
34-20	30' W of Centerline, 0.4 mi. N of RR crossing in N. Fork of Ware Rd.	28 Apr. 56	0-4%	—	10' -1" +	Hagerstown silt Loam	20A	Friable silt loam.	Brown	0" - 29"
							20B	Sticky and plastic clay loam, many small black concretions (some ½" dia.)	Bright reddish-brown	29" - 101"
							20C	Friable clay loam, many large black concretions (½" dia.)	Yellowish-brown	101" - 121" +
34-24	30' W of Russell Cave Rd, 0.2 mi. N of Loradale.	5 May 56	0-4%	6' -8"	7' -0"	Hagerstown Silt Loam.	24A	Friable silt loam	Brown	0" - 13"
							24B	Friable silt clay loam, small black concretions which increase in size and number at 35"	Reddish-brown	13" - 55"
							24C	Firm and sticky clay loam, many concretions.	Yellowish-brown	55" - 84"
34-26	135' E of Nicholasville Rd. 500' N of Wilson Rd.	12 May 56	0-4%	--	9' -1" +	Hagerstown silt Loam.	26A	Friable silt loam	Brown	0" - 20"
							26B	Friable silt clay loam, slightly firm, small black concretions.	Reddish-brown	20" - 44"
							$26C_1$	Firm but friable silty clay loam, few small black concretions, grayish streaks increase with depth.	Yellowish-brown	44" - 80"
							$26C_2$	Firm, friable silty clay loam, much black and gray mottling.	Yellowish-brown	80" - 109" +
						HUNTINGTON SERIES				
34-44	100' W of Mt. Horeb Rd, 50' N of N. Elkhorn Creek.	13 Sept 56	0-4%	--	2' - 6" +	Huntington Silt Loam, high bottom phase.	44A	Dense but friable silt loam	Brown	0" - 9"
							44C	Dense friable silt loam	Brown	9" - 30" +
34-45	80' E of Russell Cave Rd, 30' N of North Elkhorn Creek.	13 Sept 56	0-4%	None	5' - 3"	Huntington Silt Loam, high bottom phase.	45A	Friable silt loam	Brown	0" - 16"
							$45C_1$	Very friable silt loam, near uniform size, white and some black inclusions.	Brown	16" - 50"
							$45C_2$	Friable silt loam, many black and rust brown concretions, contains rust colored gravel.	Brown	50" - 63"
						LORADALE SERIES				
34-2	110' N of Lexington-Winchester Rd, 0.3 mi. W of intersection of US 60 & Ky. 859.	14 Mar 56	0-4%	3' - 10"	6' - 2" +	Loradale Silt Loam,	2A	Friable silt loam.	Brown	0" - 22"
							2B	Firm silty clay, few black concretions.	Reddish-brown	22" - 46"
							2C	Plastic, sticky clay	Brownish-yellow to yellow.	46" - 72" +
34-10	930' S of Stone Rd, E of Southern RR.	22 Feb 55	--	—	--	Loradale Silt Loam.	10A	--	--	0" - 12"
34-18	30' E of Combs Ferry Rd, 0.4 mi. E of Pine Grove.	23 Apr 56	0-4%	None	6' - 3"	Loradale Silt Loam.	18A	Friable silt loam.	Brown	0" - 22"
							18B	Friable silty clay loam, many black concretions, gray mottling increasing rapidly at 43."	Reddish-brown slight yellowish tinge.	22" - 71"
							18C	Friable clay, black mottling, rock fragments encountered at 71" - 80"	Dark reddish-brown, yellowish tinge.	71" - 80"
34-21	40' W of Cleveland Rd, 1.3 mi N of US 60.	23 Apr 56	0-4%	None	6' - 3"	Loradale Silt Loam.	21A	Friable silt loam, small black concretions.	Grayish-brown, top 6" - chocolate brown.	0" - 18"
							21B	Moderately friable silty clay, many small black concretions.	Reddish-brown	18" - 52"
							21C	Friable silty clay, few black concretions, clods have flecy appearance.	Yellowish-brown	52" - 75"
34-25	35' N of Ironworks Rd, 600' W of Newtown Pike.	5 May 56	0-4%	6' - 2"	7' -4"	Loradale Silt Loam.	25A	Friable silt loam.	Grayish-brown	0" - 23"
							25B	Sticky clay loam, small black concretions, concretionary splotches.	Reddish-brown slight yellowish tinge.	23" - 60"
							25C	Sticky clay, black concretions,	Yellowish-brown	60" - 88"
34-34	40' E of Crawley Lane, 700' S of Jacks Creek Rd.	14 May 56	0-4%	--	4' -8" +	Loradale Silt Loam.	34A	Friable silt loam.	Brown	0" - 32"
							34B	Friable gritty clay loam, many moderate sized black concretions.	Reddish-brown, slight yellowish tinge in lower portion.	32" - 56" +

TABLE 5 (CONTINUED)

Site No	Location Description	Date Sampled	Slope Class	Water Table Depth	Solid Rock Depth	Pedological Soil Type	Sample No.	Field Description	Color	Horizon Depth
							MANSE SERIES			
34-43	60' E of Mt. Horeb Rd, 300' S of North Elkhorn Creek.	18 Sept 56	0-4%	2' - 11"	3' - 1"	Manse Silt Loam.	43A	Friable silt loam	Dark Brown	0" - 6"
							43B	Friable silt loam	Brown	6" - 22"
							43C	Friable silt loam	Black	22" - 37"
							MAURY SERIES			
34-4	0.4 mi. NW of Hospital entrance on Lexington-Frankfort Rd, US 421 E of Rd, SE of RR.	Sept 54	—	—	—	Maury Silt Loam, Slope Phase	4A	—	—	—
							$4B_1$	—	—	—
							$4B_2$	—	—	—
							4C	—	—	—
34-5	100' N of Ironworks Rd, 600' E of intersection of Russel Cave Rd.	Sept 54	—	—	—	Maury Silt Loam.	5A	—	—	—
34-6	1.2 mi. W of Boone Creek on 1st Rd to the S-South of Nihizertown.	Oct 54	—	—	—	Maury Silt Loam.	6A	—	—	—
							$6B_1$	—	—	—
							$6B_2$	—	—	—
							6C	—	—	—
34-7	0.6 mi. SW of Cave Hill Rd on Lexington-Harrodsburg Rd, US 68, 75' SE of Road. Samples from face of cut.	Sept 54	—	—	—	Maury Silt Loam.	7A	—	—	—
							$7B_1$	—	—	—
							$7B_2$	—	—	—
							7C	—	—	—
34-11	100' E of Russell Cave Rd, 600' N of intersection with Ironworks Rd.	Sept 54	—	—	—	Maury Silt Loam.	11A	—	—	—
							$11B_1$	—	—	—
							$11B_2$	—	—	—
							11C	—	—	—
34-12	75' E of Clays Mill Rd, 200' N of Holly Hill Drive.	26 Mar 56	0-4%	5' -10"	9' - 0" +	Maury Silt Loam, grayish-brown phase.	12A	Friable Silt Loam	Grayish-Brown	0" - 16"
							$12B_1$	Sticky Clay, small black concretions.	Reddish-brown	16" - 48"
							$12B_2$	Increasingly friable, black concretions increase in number	Yellowish-brown, grayish mottling near bottom.	48" - 70"
							12C	Heavy Clay, many black concretions; at 108", reddish-brown, friable silt loam.	Yellowish-brown, gray & black mottling inc.	70" - 108" +
34-13	200' N of Holly Hill Drive, 800' E of Clays Mill Rd.	30 Mar 56	4-16%	—	10' -5" +	Maury Silt Loam Slope Phase	13A	Friable Silt Loam.	Brown	0" - 10"
							$13B_1$	Slightly plastic clay becoming friable in lower portion, black concretions increase in number with depth.	Reddish-brown, changes to reddish-black near bottom.	10" - 75"
							$13B_2$	Friable Silt Loam, black concretions, gray sticky mottling encountered at 125"	Yellowish-brown, yellow inc. w/depth	75" - 125" +
34-14	25' N of Military Rd, 1.5 mi. E of Little Texas.	11 Apr 56	0-4%	—	9' - 9" +	Maury Silt Loam	14A	Friable Silt Loam, numerous roots.	Brown	0 - 48"
							$14B_1$	Sticky Heavy Clay Loam, black concretions.	Reddish-brown	48" - 102"
							$14B_2$	Firm, friable clay, rock fragment 90" - 117" stopped sampling at 117". No sample.	Yellowish-brown	102" - 117" +
34-16	25' NW of Bowman Rd. 0.6 mi. S of Parkers Mill Rd.	23 Apr 56	4-16%	None	4' -5"	Maury Silty Clay Loam, Slope Phase	16B	Friable Silty Clay Loam, rock fragments at 3' - 6"	Grayish-brown	0" - 42"
							16C	Stiff Clay Loam, few black concretionary splotches.	Reddish-brown, slight yellowish mottling.	42" - 53"
34-17	25' S of Athens-Boonesboro Rd, 1.1 mi. E of Athens. Samples from face of cut.	28 Apr 56	0-4%	None	6' - 0"	Maury Silty Clay Loam, Slope Phase	17A	Friable Silt Loam	Dark Brown	0" - 18"
							17B	Friable Clay Loam, small black concretions.	Reddish-brown	18" - 68"
							17C	Plastic Clay Loam, with sticky light gray mottling. No sample.	Dark reddish-brown	68" - 72"

TABLE 5 (CONTINUED)

Site No	Location Description	Date Sampled	Slope Class	Water Table Depth	Solid Rock Depth	Pedological Soil Type	Sample No.	Field Description	Color	Horizon Depth
						MERCER SERIES				
34-1	120' N of Lexington-Winchester Rd, US 60, 0.5 mi W of Clark Co. Line.	14 Mar 56	0-4%	6'-6"	6'-5" ≠	Mercer Silt Loam.	1A	Friable Silt Loam	Blackish-gray	0" - 22"
							1B	Silty Clay, clay content increases with depth, black concretions	Brownish-yellow	22" - 48"
							1C	Firm Silty Clay, black concretions, brown mottling.	Brownish-yellow	48" - 50" ≠
34-15	300' W of RR and Rd Intersection at Walnut Hill Station, samples from 6' cut face S of RR	15 Apr 56	0-4%	None	9'-3"	Mercer Silt Loam	15A	Friable Silt Loam.	Brownish-gray	0" - 18"
							15B	Friable Silt Clay, many black concretions.	Reddish-Brown	18" - 65"
							15C	Friable Clay Loam, black concretions give way to grit and gravel in large amounts.	Bright Brownish-yellow	65" - 99"
34-19	40' S of Ware Rd, 0.4 mi. N of L&N RR Crossing.	26 Apr 56	0-4%	None	3'-2"	Mercer Silty Clay Loam, eroded phase	19A	Friable Silt Loam.	Brown	0" - 23"
							19B	Silty Clay Loam, black concretions and mottling.	Reddish-brown, yellow tinge.	23" - 38"
34-23	30' W of the Hume-Bedford Rd, 500' S of the Greenwich Rd Intersection.	5 May 56	0-4%	3'-7"	6'-8" ≠	Mercer Silty Clay Loam, eroded phase	23A	Friable Silt Loam.	Brown	0-4"
							23B	Plastic Clay, Gray mottling, Red streaks, few black concretions.	Yellowish-brown	4"-32"
							23C	Plastic Clay with reddish streaks (planes of weakness), small, black concretions.	Gray, reddish coloring increase with depth.	32"-80" ≠
						NICHOLSON SERIES				
34-30	60' W of Jacks Creek Rd, 1.7 mi SE of Dry Branch Rd Intersection.	12 May 56	0-4%	None	3'-11"	Nicholson Loam.	30A	Friable Loam	Brown	0" - 8"
							30B	Friable Sandy Clay Loam, black concretions and mottling siltstone fragments at 24"-26"	Bright reddish-brown	8" - 31"
							30C	Friable Sandy Clay Loam, very dense (believed to have been in soft ss and siltstone) black and grey mottling, few small black concretions.	Yellowish-brown, slight reddish tinge.	31" - 47"
31-39	60' E of Private Rd off to E of Dry Branch Rd, 1.1 mi. S of Jacks Creek Rd.	19 May 56	16-55%	None	2'-1"	Nicholson Loam	39A	Friable Silt Loam, many roots.	Brown	0" - 10"
							39B	Firm Clay, small black concretions, gray mottling.	Yellowish-brown	10" - 25"
34-41	60' W of Jacks Creek Rd, 2.3 mi SE of Dry Branch Rd Intersection.	4 Jun 56	4-16%	None	1'-1"	Nicholson Loam	41A	Friable Silt Loam, few black concretions. No sample.	Brown	0" - 4"
							41B	Friable Clay Loam, few small black concretions, many soft yellow siltstone fragments.	Yellowish-brown	4" - 13"
34-42	30' W of Jacks Creek Rd, 2.1 mi SE of Dry Branch Rd Intersection.	4 Jun 56	0-4%	None	5'-1"	Nicholson Loam	42A	Friable Loam	Light brown; top 7"-dark brown.	0" - 14"
							$42B_1$	Silt Loam, black concretions.	Reddish-brown, slight yellowish tinge.	14" - 29"
							$42B_2$	Friable Silty Clay, black concretions which increase in size and number with depth, grey mottling.	Yellowish-brown	29" - 50"
							42C	Firm, Friable Clay Loam.	Yellowish-brown, slight grey tinge.	50" - 61"
						SALVISA SERIES				
34-22	60' N of Spears Rd, 0.5 mi N of Tates Creek Rd.	30 Apr 56	4-16%	None	2'-7"	Salvisa Silty Clay Loam.	22A	Friable Sandy Silt Loam, stony, many roots.	Light brown	0" - 8"
							22B	Friable Sandy Silt Loam.	Brown	8" - 24"
							22C	Tough, Sticky Clay, few small black concretions.	Reddish-brown	24" - 31"
34-37	50' E of Crawley Lane, 0.9 mi E of Tates Creek Rd.	19 May 56	4-16%	None	4'-7"	Salvisa Silty Clay Loam	37A	Friable Silt Loam, 0" - 12" Flat Ls fragments on surface.	Brown, slight reddish tinge.	0" - 6"
							37B	Friable Silt Loam.	Brown	6" - 23"
							37C	Friable Silty Clay Loam, many black concretions which increase in size (1" Dia.) and number at 45"	Dark reddish-brown	23" - 55"
34-38	35' W of Spears Rd, 0.2 mi S of Jacks Creek Rd.	19 May 56	4-16%	None	6'-1"	Salvisa Silty Clay Loam.	38A	Friable Silt Loam	Brown	0" - 30"
							38B	Friable Silty Clay Loam, many small black concretions.	Reddish-brown	30" - 47"
							38C	Sticky Clay Loam, many black concretions which increase in size and number at 60"	Yellowish-brown	47" - 73"

TABLE 61 SUMMARY OF LABORATORY DATA

Sample No.	Liquid Limit	Plasticity Index	Specific Gravity	Grain Size Distribution: 2.0–0.05mm % Sand	Grain Size Distribution: 0.05–0.005mm % Silt	Grain Size Distribution: 0.005mm % Clay	Grain Size Distribution: 0.001mm % Colloids	Std. Proctor: Maximum Density	Std. Proctor: Opt. M.C.	Lab. CBR	Classification: U.S. Bureau of Soils	Classification: Miss. River Commission	Classification: HRB	Clay Minerals
BURGIN SERIES														
34-9A	34.8	12.6	2.67	15.3	61.4	23.3	10.1	98.6	23.0	--	Silty Clay Loam	Clay Silt	A-6(9)	--
34-35A	46.7	19.8	2.67	17.0	62.0	21.0	5.5	94.9	23.5	7.7	Silty Clay Loam	Clay Silt	A-7-6(13)	--
34-46A	46.6	16.5	2.63	8.0	62.5	28.5	9.0	88.2	26.7	4.0	Silty Clay Loam	Clay Silt	A-7-6(12)	--
34-47A	36.8	9.5	2.66	14.0	64.5	21.5	7.0	98.4	21.2	5.3	Silty Clay Loam	Clay Silt	A-4(6)	--
34-9B	38.0	11.7	2.80	28.0	39.0	33.0	14.0	94.7	23.5	--	Clay	Silty Clay	A-6(6)	--
34-46B	64.7	20.7	2.78	26.0	47.0	27.0	11.5	101.0	21.3	--	Clay Loam	Clay Silt	A-7-6(13)	*
34-47B	48.2	13.8	2.73	22.0	63.0	15.0	5.0	92.0	27.0	--	Silty Loam	Sandy Silt	A-7-5(11)	--
34-46C	44.7	18.7	2.97	49.0	39.0	12.0	7.0	107.5	21.3	8.3	Loam	Silty Sand	A-7-6(7)	*
34-47C	47.1	20.4	2.73	38.0	42.0	20.0	10.0	97.5	24.2	--	Clay Loam	Clay Silt	A-7-6(11)	--
CAPTINA SERIES														
34-32A	42.7	17.3	2.75	10.0	48.0	42.0	14.5	86.6	24.1	5.0	Clay	Silty Clay	A-7-6(11)	--
34-32B	52.9	27.2	2.74	7.0	44.0	49.0	18.0	93.7	23.6	7.0	Clay	Silty Clay	A-7-6(17)	Illite
CULLEOKA SERIES														
34-27A	43.7	25.7	2.69	11.0	54.0	33.0	12.0	95.6	23.0	5.7	Clay	Silty Clay	A-7-6(15)	--
34-29A	--	--	--	--	--	--	--	--	--	--	--	--	--	--
34-27B	38.6	18.0	2.75	9.5	40.5	50.0	25.0	99.2	22.6	3.6	Clay	Clay or Silty Clay	A-6(11)	--
34-29B	46.3	21.6	2.79	10.0	34.0	56.0	25.0	97.8	23.4	2.4	Clay	Clay	A-7-6(14)	Illite
CONERAOL SERIES														
34-8A	33.8	10.9	--	--	--	--	--	--	--	--	--	--	A-6(--)	--
34-8B	29.9	7.8	2.73	16.1	57.0	26.9	10.4	106.3	18.4	--	Silty Clay Loam	Clay Silt	A-4(8)	--
EDEN SERIES														
34-3A	37.2	13.8	2.73	6.5	53.0	40.5	16.0	103.3	19.9	9.0	Clay	Silty Clay	A-6(10)	--
34-31A	57.4	24.2	2.72	6.0	36.0	58.0	21.5	89.4	29.0	4.0	Clay	Clay	A-7-5(17)	--
34-36A	53.7	20.6	2.66	21.5	49.5	29.0	10.0	87.6	28.0	4.6	Clay Loam	Clay Silt	A-7-5(15)	--
34-3B	46.2	20.1	2.76	12.5	39.5	49.0	21.0	97.5	24.5	3.2	Clay	Silty Clay	A-7-6(13)	--
34-31B	57.2	29.3	2.75	0.0	36.0	64.0	30.0	92.8	25.7	4.6	Clay	Clay	A-7-6(19)	Illite
34-36B	55.1	25.7	2.75	7.5	36.5	56.0	25.0	92.6	27.4	2.0	Clay	Clay	A-7-6(17)	--
34-3C	59.0	27.0	2.81	8.5	33.5	58.0	26.5	98.9	24.6	1.5	Clay	Clay	A-7-5(19)	Illite
34-31C	57.2	29.3	2.75	0.0	36.0	64.0	30.0	97.8	25.7	4.6	Clay	Clay	A-7-6(19)	Illite
34-36C	48.4	23.9	2.68	4.5	34.5	61.0	28.0	99.6	20.0	2.8	Clay	Clay	A-7-6(15)	Illite
ELK SERIES														
34-28A	24.2	2.0	2.67	68.0	13.0	19.0	7.0	109.5	16.0	6.3	Sandy Loam	Silty Sand	A-4(8)	--
34-33A	NL	NP	2.68	81.5	11.5	7.0	1.5	109.1	13.0	28.6	Sand	Sand	A-2-4(0)	--
34-40A	NL	NP	2.68	86.5	7.5	4.0	1.0	102.4	15.7	13.0	Sand	Sand	A-2-4(0)	--
34-28B	25.0	5.5	2.69	38.5	33.5	28.0	13.0	110.0	16.3	10.3	Clay Loam	Clay Sand or Clay Silt	A-4(7)	--
34-33B	NL	NP	2.68	61.5	23.5	15.0	6.0	111.0	15.0	10.0	Sandy Loam	Silty Sand	A-4(2)	--
34-40B	NL	NP	2.68	66.0	20.0	14.0	6.0	109.3	17.2	12.0	Sandy Loam	Silty Sand	A-4(2)	--
34-33C	NL	NP	2.69	66.0	24.0	10.0	5.0	102.8	16.4	12.7	Sandy Loam	Silty Sand	A-4(2)	Kaolinite & Illite
34-40C	NL	NP	2.67	53.0	27.5	19.5	3.5	106.4	17.1	11.3	Sandy Loam	Silty Sand	A-4(5)	--
HAGERSTOWN SERIES														
34-20A	33.0	11.6	2.68	8.0	58.0	34.0	10.0	101.2	21.4	7.0	Silty Clay	Silty Clay	A-6(9)	--
34-24A	36.1	10.7	2.63	17.0	54.0	29.0	12.0	--	--	--	Silty Clay Loam	Clay Silt	A-6(8)	--
34-26A	37.1	13.1	2.72	12.0	51.0	37.0	17.0	101.0	22.0	6.7	Clay	Silty Clay	A-6(9)	--
34-20B	37.9	16.9	2.74	14.0	54.0	32.0	14.5	102.7	20.9	9.6	Clay	Silty Clay	A-6(11)	--
34-24B	40.8	19.5	2.74	17.0	56.0	27.0	10.0	100.6	23.4	5.9	Silty Clay Loam	Clay Silt	A-7-6(12)	--
34-26B	42.7	17.3	2.77	10.0	37.0	45.0	20.5	95.6	24.1	9.7	Clay	Silty Clay	A-7-6(12)	--
34-20C	37.4	12.8	2.87	36.0	32.0	32.0	17.0	105.2	22.4	--	Clay	Sandy Clay	A-6(8)	--
34-24C	53.4	27.9	2.89	23.5	32.0	44.5	23.0	89.2	30.0	2.7	Clay	Silty Clay	A-7-6(18)	Illite
34-26C$_1$	51.7	21.0	2.90	16.0	27.0	55.0	34.0	91.0	27.4	2.9	Clay	Clay	A-7-6(16)	--
34-26C$_2$	47.7	22.0	2.81	11.5	32.5	56.0	31.0	96.9	25.7	2.4	Clay	Clay	A-7-6(14)	--
HUNTINGTON SERIES														
34-44A	36.1	9.6	2.68	10.5	58.5	31.0	10.5	98.0	21.8	4.0	Silty Clay	Silty Clay	A-4(8)	--
34-45A	35.0	9.5	2.67	13.0	62.0	25.0	10.0	90.4	26.7	4.7	Silty Clay Loam	Clay Silt	A-4(8)	--
34-44C	36.8	15.1	2.72	5.5	58.5	36.0	9.0	103.0	20.0	--	Silty Clay	Silty Clay	A-6(10)	--
34-45C$_1$	47.4	15.8	2.79	52.5	31.5	16.0	7.0	102.7	22.1	--	Sandy Loam	Silty Sand	A-7-5(6)	*
34-45C$_2$	40.1	13.1	2.78	56.0	23.5	20.5	10.0	103.3	23.9	--	Sandy Clay Loam	Clay Sand	A-7-6(3)	*
LORADALE SERIES														
34-2A	36.9	11.3	2.64	8.0	56.0	36.0	11.5	98.3	20.0	3.0	Silty Clay	Silty Clay	A-6(9)	--
34-10A	36.8	16.3	2.71	18.1	53.2	28.7	11.7	107.3	20.1	--	Silty Clay Loam	Clay Silt	A-6(10)	--
34-18A	33.9	10.9	2.71	13.0	64.0	23.0	8.0	101.0	20.9	9.3	Silty Clay Loam	Clay Silt	A-6(8)	--
34-21A	31.9	10.5	2.70	13.0	61.0	28.0	8.0	104.0	19.6	7.5	Silty Clay Loam	Clay Silt	A-6(8)	--
34-25A	41.8	13.9	2.66	11.5	61.0	27.5	6.5	96.6	23.6	6.2	Silty Clay Loam	Clay Silt	A-7-6(10)	--
34-34A	33.4	13.3	2.67	9.5	61.5	29.0	6.5	97.6	22.2	10.0	Silty Clay Loam	Clay Silt	A-6(9)	--
34-2B	42.1	23.2	2.75	17.0	40.0	43.0	19.0	104.4	21.7	4.5	Clay	Silty Clay	A-7-6(10)	--
34-18B	37.4	15.7	2.91	39.5	22.5	38.0	19.0	92.9	26.2	--	Clay	Sand Clay	A-7-5(9)	--
34-21B	38.3	17.1	2.76	20.0	44.0	36.0	14.5	100.3	24.8	5.4	Clay	Silty Clay	A-6(11)	--
34-25B	37.5	15.6	2.75	26.0	45.0	29.0	11.5	102.5	21.0	9.8	Clay Loam	Clay Silt	A-6(10)	--
34-34B	30.0	9.5	2.73	24.0	44.0	32.0	12.5	104.8	20.0	20.0	Clay	Silty Clay	A-4(8)	--
34-2C	58.7	29.1	2.82	13.0	28.5	58.5	34.0	83.6	29.6	5.7	Clay	Clay	A-7-6(20)	--
34-18C	51.6	21.2	2.82	22.0	26.5	51.5	35.0	85.6	33.2	--	Clay	Clay	A-7-5(15)	--
34-21C	53.6	18.6	2.75	21.0	28.0	51.0	32.0	90.2	29.3	6.3	Clay	Clay	A-7-5(14)	Illite
34-25C	56.6	30.0	2.68	21.0	26.5	52.5	31.0	89.5	28.4	--	Clay	Clay	A-7-6(19)	--

* X-ray diffraction pattern inconclusive.

TABLE 61 (CONTINUED)

Sample No.	Liquid Limit	Plasticity Index	Specific Gravity	Grain Size Distribution: 2.0-0.05mm % Sand	0.05-0.005mm % Silt	0.005mm % Clay	0.001mm % Colloids	Std. Proctor: Maximum Density	Opt. M.C.	Lab. CBR	Classification: U.S. Bureau of Soils	Miss. River Commission	HRB	Clay Minerals
MANSE SERIES														
34-43A	37.0	3.4	2.62	19.0	61.0	20.0	3.0	88.2	28.2	4.7	Silty Clay Loam	Clay Silt	A-4(8)	—
34-43B	39.4	13.0	2.67	7.5	73.5	19.0	5.0	96.1	23.0	5.3	Silty Loam	Sandy Silt	A-6(9)	—
34-43C	36.3	5.7	2.70	23.0	57.0	20.0	8.0	93.8	25.3	—	Silty Loam or Silty Clay Loam	Sandy Silt or Clay Silt	A-4(8)	*
MAURY SERIES														
34-4A	38.2	9.2	2.68	6.0	59.5	34.5	12.0	—	—	—	Silty Clay	Silty Clay	A-4(8)	—
34-5A	40.3	15.3	—	—	—	—	—	—	—	—	—	—	A-7-6(--)	—
34-6A	35.8	14.5	2.69	6.2	57.4	36.4	12.5	—	—	—	Silty Clay	Silty Clay	A-6(10)	—
34-7A	31.6	8.9	—	—	—	—	—	—	—	—	—	—	A-4(--)	—
34-11A	37.2	12.7	—	—	—	—	—	—	—	—	—	—	A-6(--)	—
34-12A	36.6	14.0	2.72	11.0	59.0	30.0	14.0	101.1	20.7	8.7	Silty Clay	Silty Clay	A-6(10)	—
34-13A	33.0	10.8	2.74	13.0	58.0	29.0	14.0	102.1	20.5	9.0	Silty Clay Loam	Clay Silt	A-6(8)	—
34-14A	38.0	11.7	2.72	3.5	54.0	42.5	7.5	92.3	25.2	4.7	Clay	Silty Clay	A-6(9)	—
34-17A	38.5	12.9	2.70	18.0	55.0	27.0	9.5	97.6	23.8	18.7	Silty Clay Loam	Clay Silt	A-6(9)	—
34-4B$_1$	41.9	16.5	2.76	10.0	47.0	43.0	21.5	100.1	22.4	—	Clay	Silty Clay	A-7-6(11)	—
34-6B$_1$	43.6	22.8	2.76	—	—	—	—	103.1	21.1	—	—	—	A-7-6(—)	—
34-7B$_1$	44.4	18.6	—	—	—	—	—	102.6	20.6	—	—	—	A-7-6(—)	—
34-11B$_1$	38.0	16.3	2.74	—	—	—	—	99.4	23.2	—	—	—	A-6(--)	—
34-12B$_1$	35.9	15.1	2.74	15.5	49.5	35.0	12.0	102.8	20.7	11.2	Clay	Silty Clay	A-6(10)	—
34-13B$_1$	40.7	17.1	2.73	15.0	48.5	36.5	18.0	103.8	20.8	10.7	Clay	Silty Clay	A-7-6(11)	—
34-14B$_1$	39.3	19.2	2.74	12.0	49.0	39.0	15.0	103.0	21.5	10.8	Clay	Silty Clay	A-6(11)	—
34-16B	37.2	10.6	2.67	20.0	57.0	23.0	7.0	93.2	24.1	5.3	Silty Clay Loam	Clay Silt	A-6(8)	—
34-17B	38.1	14.8	2.80	21.5	40.0	28.5	11.5	97.8	25.0	7.4	Clay Loam	Clay Silt	A-6(9)	—
34-4B$_2$	50.6	20.8	2.84	12.5	36.5	51.0	31.0	94.8	27.0	—	Clay	Silty Clay	A-7-6(14)	—
34-6B$_2$	49.2	26.1	—	—	—	—	—	97.8	23.7	—	—	—	A-7-6(--)	—
34-7B$_2$	51.6	20.1	—	—	—	—	—	98.0	25.4	—	—	—	A-7-5(--)	—
34-11B$_2$	47.0	20.2	—	—	—	—	—	91.2	29.4	—	—	—	A-7-6(—)	—
34-12B$_2$	45.8	17.3	2.79	21.0	38.5	40.5	23.0	97.0	24.3	8.1	Clay	Silty Clay	A-7-6(12)	—
34-13B$_2$	58.5	20.8	2.84	17.0	25.5	57.5	40.0	89.4	31.6	6.2	Clay	Clay	A-7-5(16)	—
34-4C	47.4	19.7	2.80	19.0	39.0	42.0	21.0	—	—	—	Clay	Silty Clay	A-7-6(13)	—
34-6C	67.4	38.4	—	—	—	—	—	102.4	35.6	—	—	—	A-7-6(—)	—
34-7C	52.0	18.3	—	—	—	—	—	89.6	30.0	—	—	—	A-7-5(—)	—
34-11C	46.5	20.2	2.76	—	—	—	—	93.9	25.0	—	—	—	A-7-6(--)	—
34-12C	62.7	31.7	2.82	13.5	28.5	58.0	37.0	92.2	24.6	3.3	Clay	Clay	A-7-5(20)	Illite
34-16C	41.7	18.5	2.77	24.0	40.0	36.0	18.5	95.4	25.7	—	Clay	Silty Clay	A-7-6(12)	—
MERCER SERIES														
34-1A	35.2	8.8	2.68	13.0	58.0	29.0	8.0	103.1	18.8	4.0	Silty Clay Loam	Clay Silt	A-4(8)	—
34-15A	38.9	9.1	2.54	19.0	60.0	21.0	7.0	87.6	23.2	9.0	Silty Clay Loam	Clay Silt	A-4(8)	—
34-19A	40.0	11.4	2.68	23.0	51.0	26.0	5.0	99.1	23.5	6.7	Silty Clay Loam	Clay Silt	A-6(9)	—
34-23A	41.5	13.7	2.62	8.5	61.0	30.5	9.0	—	—	—	Silty Clay	Silty Clay	A-7-6(10)	—
34-1B	35.3	16.9	2.75	20.5	43.0	36.5	12.0	109.1	18.2	14.2	Clay	Silty Clay	A-6(11)	—
34-15B	38.2	13.4	2.75	17.0	49.0	34.0	14.0	104.0	20.5	11.8	Clay	Silty Clay	A-6(9)	—
34-19B	41.0	17.3	2.79	20.0	37.5	42.5	19.0	100.6	23.2	5.5	Clay	Silty Clay	A-7-6(11)	—
34-23B	39.0	18.0	2.77	13.0	55.0	32.0	14.5	101.6	20.2	—	Clay	Silty Clay	A-6(11)	—
34-1C	40.0	17.5	2.70	26.0	35.0	39.0	18.0	102.5	22.5	8.2	Clay	Silty Clay	A-6(11)	Kaolinite & Montmorillinite (Nontronite)
34-15C	34.9	10.3	2.87	34.0	34.0	32.0	20.0	104.3	21.4	15.5	Clay	Sandy Clay	A-6(8)	Kaolinite & Montmorillinite (Nontronite)
34-23C	50.7	29.1	2.80	23.0	33.0	54.0	32.0	95.2	25.0	2.2	Clay	Clay	A-7-6(18)	Illite
NICHOLSON SERIES														
34-30A	25.1	3.3	2.64	15.0	60.5	24.5	11.5	—	—	—	Silty Clay Loam	Clay Silt	A-4(8)	—
34-39A	46.0	18.4	2.79	8.0	46.0	46.0	18.0	92.1	25.6	5.8	Clay	Silty Clay	A-7-6(13)	—
34-41A	30.2	7.8	2.65	18.0	57.0	25.0	7.5	—	—	—	Silty Clay Loam	Clay Silt	A-4(8)	—
34-42A	36.0	10.6	2.68	14.0	63.5	22.5	10.0	98.0	22.0	8.0	Silty Clay Loam	Clay Silt	A-6(8)	—
34-30B	31.1	11.5	2.71	14.0	52.0	34.0	22.0	105.8	19.3	13.7	Clay	Silty Clay	A-6(9)	—
34-39B	51.6	24.3	2.72	4.0	36.0	60.0	23.0	94.4	25.2	2.2	Clay	Clay	A-7-6(16)	—
34-41B	33.4	11.4	2.71	17.0	48.0	35.0	10.5	100.6	21.6	7.8	Clay	Silty Clay	A-6(9)	—
34-42B$_1$	35.9	14.6	2.74	12.0	48.0	40.0	16.0	100.9	21.1	10.1	Clay	Silty Clay	A-6(10)	—
34-42B$_2$	41.8	17.6	2.75	18.0	44.0	40.0	20.0	100.1	22.6	8.8	Clay	Silty Clay	A-7-6(11)	—
34-30C	39.1	13.0	2.73	23.0	41.0	36.0	21.0	94.4	26.4	7.1	Clay	Silty Clay	A-6(9)	—
34-42C	38.3	15.9	2.79	18.5	41.5	40.0	23.0	—	—	—	Clay	Silty Clay	A-6(10)	Illite
SALVISA SERIES														
34-22A	29.3	7.0	2.64	20.5	60.0	19.5	6.5	—	—	—	Silty Loam	Sandy Silt	A-4(8)	—
34-37A	34.8	10.4	2.63	24.0	58.0	18.0	7.0	—	—	—	Silty Clay Loam	Clay Silt	A-6(8)	—
34-38A	34.5	7.8	2.68	17.0	53.5	29.5	5.5	101.0	21.6	7.3	Silty Clay Loam	Clay Silt	A-4(8)	—
34-22B	38.7	14.1	2.69	17.5	53.5	29.0	9.0	97.2	23.4	9.2	Silty Clay Loam	Clay Silt	A-6(10)	—
34-37B	42.7	15.1	2.66	10.5	58.5	31.0	8.5	96.0	24.1	7.0	Silty Clay	Silty Clay	A-7-6(11)	—
34-38B	31.3	11.2	2.70	12.0	57.0	31.0	10.5	102.8	20.5	14.3	Silty Clay	Silty Clay	A-6(8)	—
34-22C	62.1	32.8	2.77	18.0	38.5	43.5	22.5	84.8	29.4	3.0	Clay	Silty Clay	A-7-6(20)	—
34-37C	40.5	17.6	2.71	16.0	56.5	27.5	12.0	101.0	22.0	7.8	Silty Clay Loam	Clay Silt	A-7-6(11)	—
34-38C	37.2	18.2	2.72	13.0	45.0	42.0	20.0	98.2	23.8	5.2	Clay	Silty Clay	A-6(11)	Illite

* X-ray diffraction pattern inconclusive.

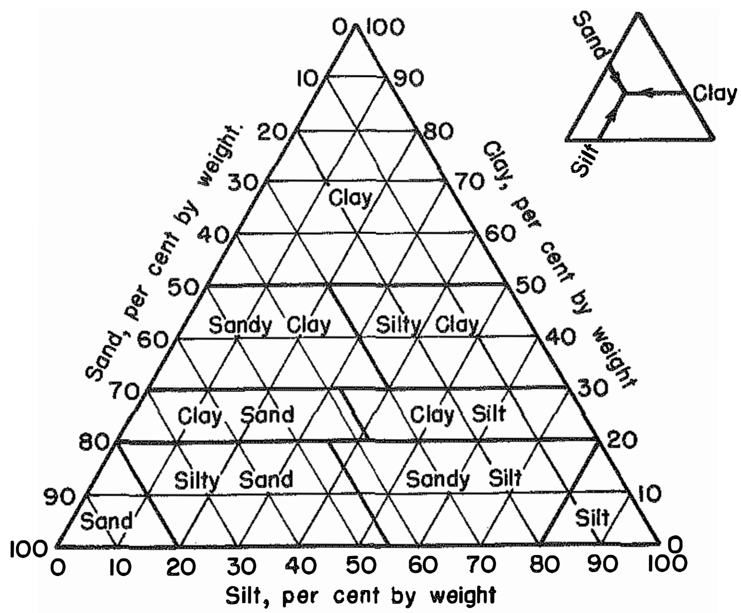

Fig. 16 - Mississippi River Commission Textural Classification Chart.

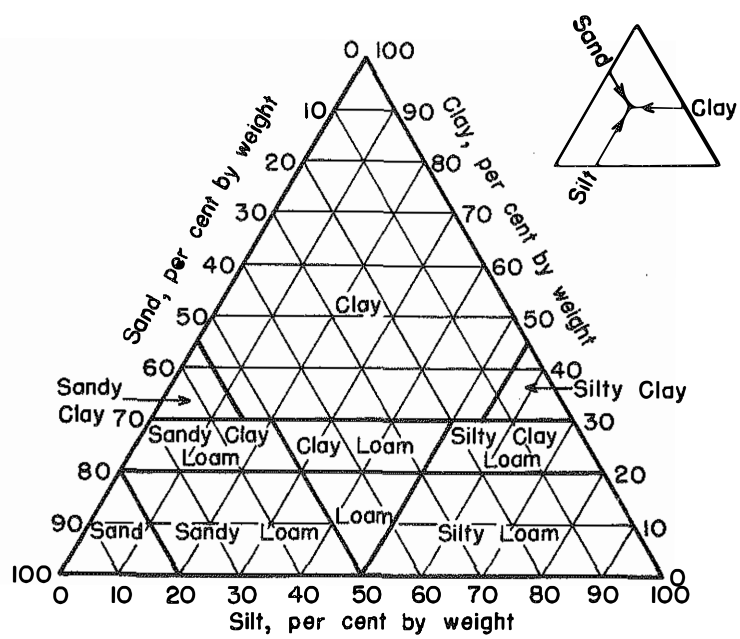

Fig. 17 - United States Bureau of Soils Textural Classification Chart.

APPENDIX IV: LIST OF APPROVED SOILS SERIES USED IN KENTUCKY

Allegheny
Allen
Almo
Armour
*Ashburn
Atkins
Atwood
Avonburg
Barbourville
Baxter
*Beasley
*Beckley
Bedford
Beechy
*Bellevue
Beulah
Bewleyville
Balgo
Bodine
Bosket
Bowdre
Brandon
*Brashear
Braxton
Bruno
Burgin
Byington
Calhoun
Calloway
*Caneyville
Capshaw
Captina
Carroll
*Caseyville
Chilo
Christian
Cincinnati
Clermont
Colbert
Collins
Colyer
Commerce
Cookeville
Coolville
Cotaco
*Crider
Crossville
*Cruse
Culleoka
Cumberland
Decatur
*Dekoven
Dexter
Dickson
Donerail
Dowellton
Dubbs
Dundee
Dunning
Eden
Edenton
Egam
Elk
Elkins
Emory
Enders
Ennis
Etowah
Fairmount
Falaya
*Falmouth
Fawcett
Forestdale
Freeland
Ginat
Greendale
Grenada
Guin
Guthrie
Hagerstown
Hamblen
Hampshire
Hanceville
Hartsells
Hatchie
Hayter
Hector
Heitt
Henry
*Henshaw
Hermitage
*Hilham
*Hitesville
*Hodgenville
Holsten
*Hooten
Humphreys
Huntington
Hymon
Ina

* Tentative Series

Iola
Jefferson
Jessup
Johnsburg
*Kenton
Kings
*Larue
Lawrence
Lax
Leadvale
Lee
Lexington
Lickdale
*Licking
Lindside
Linker
Lintonia
Lobelville
Loradale
Loring
Loudon
Lowell
McAfee
McGary
Maddox
*Malt

Manitou
*Manse
Markland
Maury
Melvin
Memphis
Mercer
MHoon
*Mobley
Monengahela
Montgomery
*Morganfield
Mountview
Mullins
Muse
Muskingum
Needmore
*Newark
Nicholson
Nolichucky
Olivier
Ooltewah
Otway
Pace
Parks
Pearman

*Pembroke
Philo
Pope
Prader
Providence
Purdy
Rarden
*Renox
Richland
Robertsville
Robinsville
*Rockcastle
*Roellen
Rossmoyne
Routon
Russellville
Salvisa
Sango
Sciotoville
*Sees
Sequatchie
Shannon
Sharkey
Shelbyville
*Siberia
Staser

Stendal
Sturgis
Sulphura
Taft
Talbott
*Tarklin
Tilsit
*Trappist
Tunica
Tyler
*Uniontown
Upshur
Vicksburg
Waverly
Waynesboro
Weinbach
Wellston
*Weon
Westmoreland
Wheeling
Whitwell
Wolftever
*Woolper
Zaleski
Zipp
*Zoar

* Tentative Series

APPENDIX V: CLAY MINERALOGY

The determination of the clay mineralogy of the soils of Fayette County was not a primary objective of this investigation; however, it was thought that some knowledge of the constitution of the clay-size particles of the soils would prove to be interesting. Therefore, a rather cursory examination of the collodial portions of selected samples was made by means of X-ray diffraction. The identification of three of the more important clay minerals occurring in soils was attempted in this portion of the study.

The X-ray diffraction analysis was predicated on the same theory used for other portions of this study: that soils of similar origin and background should exhibit similar properties. Since the plasticity and cohesive properties of soils are controlled largely by the types and quantities of the near-colloid size particles present in them, soils exhibiting similar plastic and cohesive properties should contain similar clay minerals.

From the results of earlier studies (23, 24), there is strong evidence that Ordovician rocks, and soils derived from them contain illitic clays. Samples from the Eastern Coal Field (Pennsylvanian Age) have been shown to contain kaolinite and illite, and scattered samples from the Mississippian Plateaus contain kaolinite and montmonillonite (nontronite).

The results of the X-ray diffraction of selected samples from Fayette County, with the exception of two cases both from the same soil series, lend support to the general theory of soil development and to the results of the earlier studies mentioned above. The sample from the Elk Series, an alluvial soil derived from materials carried to this county from the Eastern Coal Field, contained kaolinite and illite. X-ray diffraction patterns were not obtained for two other alluvial soils (Huntington and Manse) and one residual soil (Burgin) because of interference caused by impurities which were not susceptible to treatment. The residual soils of the county which were analyzed, all Ordovician, contained only illitic clays. The two exceptions mentioned above were samples from the Mercer Series and contained kaolinite and montmorillonite (nontronite). The clay minerals in a third sample of the Mercer soil were identified as illitic. No explanation is offered at this time; however, further work is suggested in order to support or qualify the general theory and to explain the seeming inconsistency observed in this investigation.

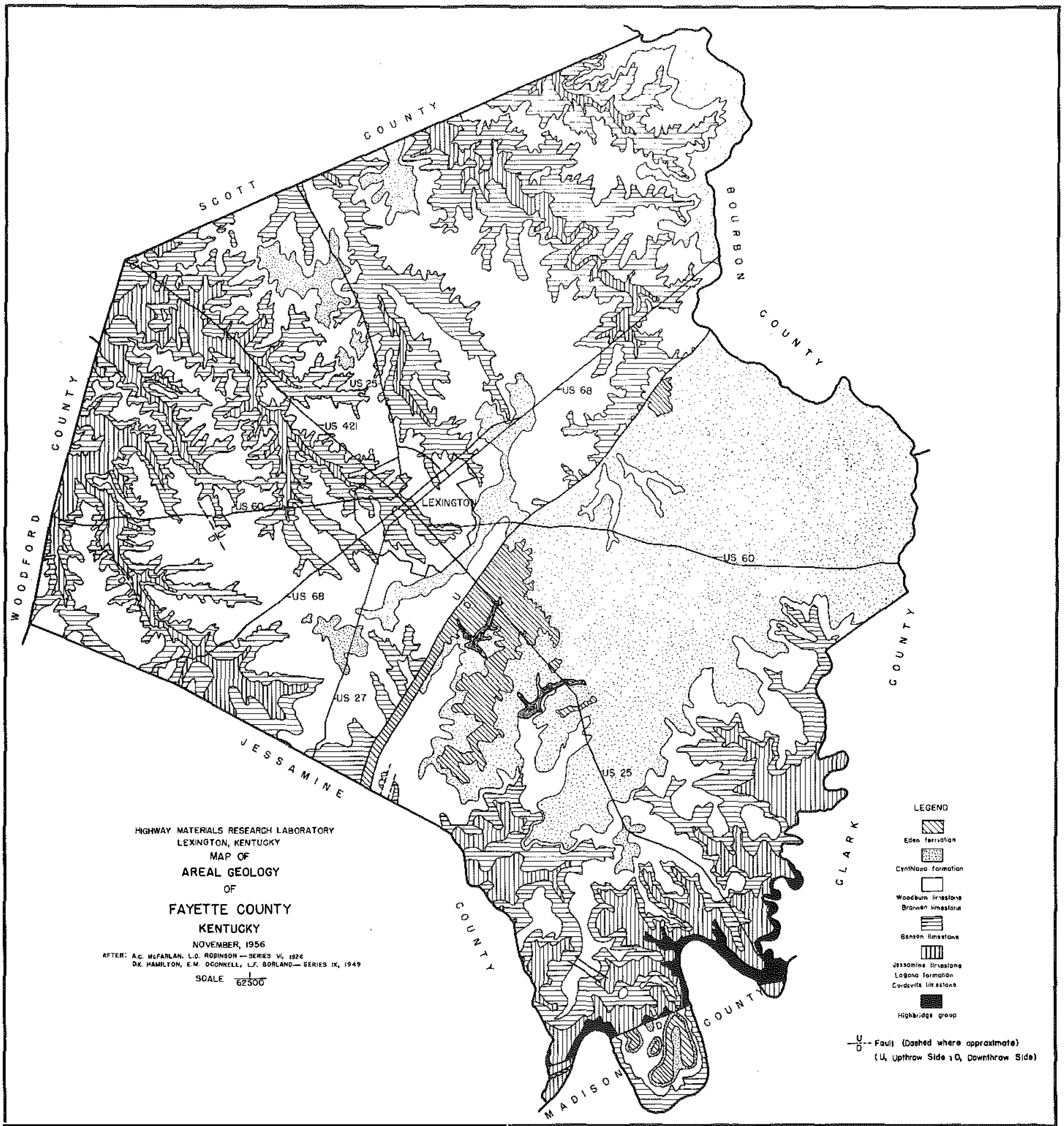

Fig. 18 - Geologic Map of Fayette County, Kentucky.

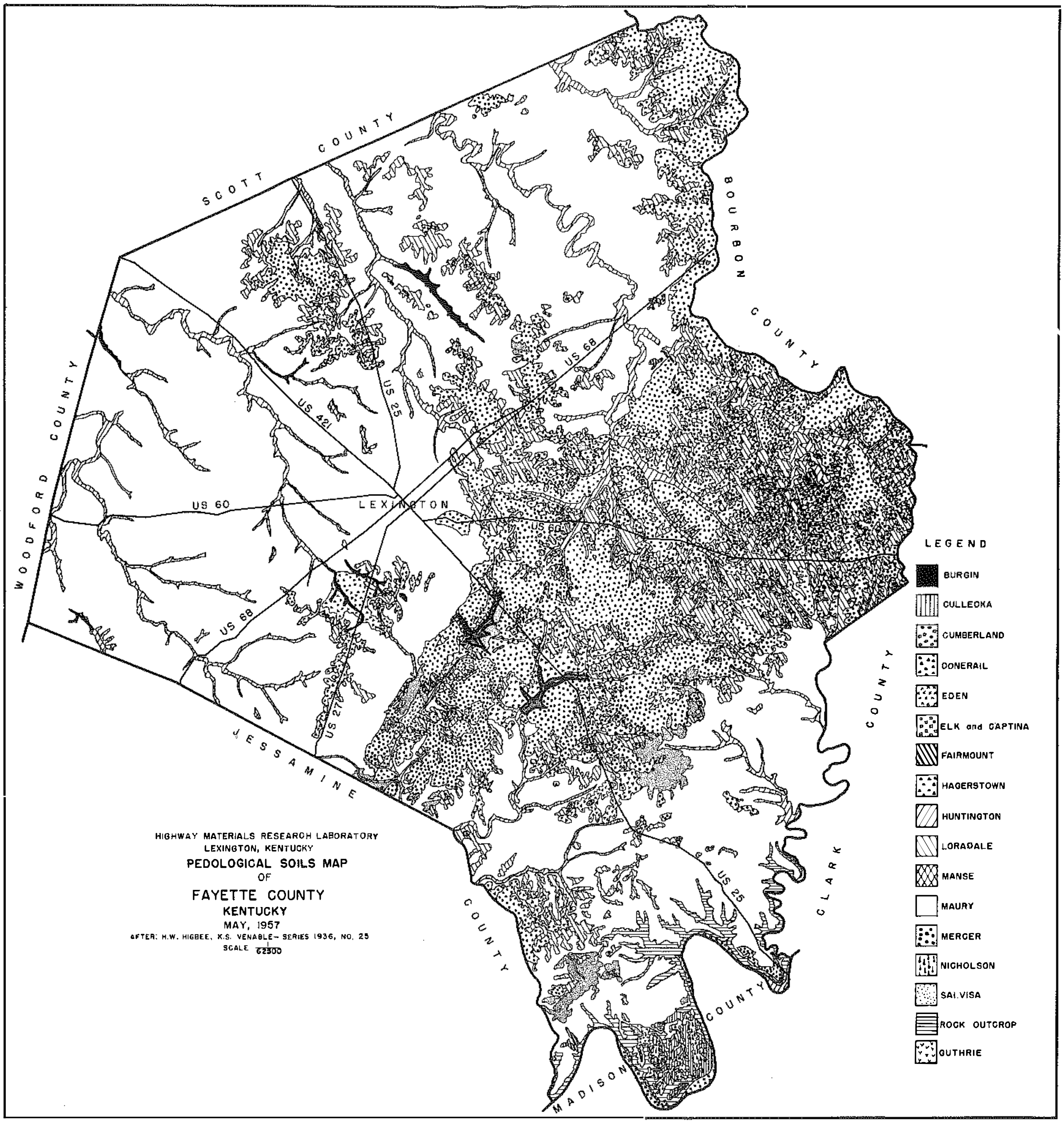

Fig. 19 - Pedological Map of Fayette County, Kentucky.

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